



<http://waikato.researchgateway.ac.nz/>

Research Commons at the University of Waikato

Copyright Statement:

The digital copy of this thesis is protected by the Copyright Act 1994 (New Zealand).

The thesis may be consulted by you, provided you comply with the provisions of the Act and the following conditions of use:

- Any use you make of these documents or images must be for research or private study purposes only, and you may not make them available to any other person.
- Authors control the copyright of their thesis. You will recognise the author's right to be identified as the author of the thesis, and due acknowledgement will be made to the author where appropriate.
- You will obtain the author's permission before publishing any material from the thesis.

**SAUDI SECONDARY SCHOOL SCIENCE
TEACHERS' PERCEPTIONS OF THE USE OF ICT
TOOLS TO SUPPORT TEACHING AND LEARNING**

**A thesis
submitted in partial fulfilment
of the requirements for the degree
of
Master of Education (ICT)
from the
University of Waikato**

**By
Osamah Abdulwahab D. Almaghlouth**



**The University of Waikato
2008**

ABSTRACT

This research was conducted to investigate the Saudi science teachers' perception of the use of Information and Communication Technology (ICT) tools to enhance teaching and learning and undertake a small and groundwork examination of these teachers current use of ICT.

It draws on the interpretive paradigm (Cohen & Manion, 1994), where the focus is on how people interpret and make sense of their world. From this interpretive perspective the beliefs of Saudi secondary school science teachers, in relation to the benefits of ICT, their current use of ICT and their perceived needs for improvement in the use of ICT in the classroom were investigated.

Saudi secondary schools science teachers from both girls' and boys' schools in three different types of schools have been involved in this study. There were 28 government schools (9 girls' and 19 boys' schools), four small schools in rented premises (2 girls' and 2 boys' schools) and four Aramco schools (1 girls' and 3 boys' schools). These schools were in different districts: Aldammam city, Alkhobar city, Aldahran city, Alqateaf city and Sufwa city. The teachers were asked to voluntarily participate in the study and 131 teachers out of 200 (86 male and 45 female, 65 %) completed the questionnaire. Analysis of the data, together with the relevant literature builds a picture of the use of ICT in science education. Providing ICT hardware and software resources to a school is not enough to ensure significant developments in use of ICT for teaching and learning in Saudi science classrooms. Access to working ICT continues to be an issue for these teachers. Although teachers identified many benefits to teachers and students from using ICT and had made individual efforts to develop their use of ICT for admin planning and lesson preparation, they also identified barriers. These barriers focused on a lack of appropriate professional development and technical support.

The findings have implications for future development in the area of ICT. It is expected that the results of the research will guide future research and development in the country and outline the importance of the use of information and communication technology in education for teachers, students, parents and decision-makers. It will contribute information towards decision-making and planning in future projects.

AKNOWLEDGMENTS

I would like here to acknowledge all those people who devoted their time to helping me on this research whether in the data collection or in the analysis or in the administering the questionnaire. I would like to also acknowledge those who were generous in providing me with advice.

I wish to thank the following people:

- My father Abdulwahab who always encourages me and supports me to work hard.
- My mother Norah who was like the Dynamo that encourages me to do my best.
- My wife Qadryah, the best advisor for me and without whose help and cooperation this research could not have been conducted. She devoted her time to create a suitable environment for me to I can study well far away from the noise of the children. She was always worrying and crying about me. Therefore, I appreciate that from her.
- My brother Dawood who supported the main step of this research which was the data collection from Saudi Arabia, he was the coordinator for this research. He did this task very well.
- My best job colleague in Saudi Arabia Mr. Moammar Alzahrani who help me in the data collection step.
- My cousin Mrs Khloud Almaghlouth, she helps in the data collection step as well.
- All the teachers who participated in this research whether female or male teachers.
- Vanwyk and Franco my work friends who are with me in our office in the Waikato University, they helped me to develop my questionnaire.
- Special thanks to my sons Abdulwahab and Adel, who encouraged me to finish my research on time by asking me in every week when I will finish my research so they can return to Saudi Arabia.
- Finally, my supervisor Kerry Earl for her unwavering support and critical observations that made my final report much better than the first draft. And for the previous supervisor Dr. Judy Moreland who retired early in the first stage of my research.

TABLE OF CONTENTS

Abstract	ii	
Acknowledgements	iii	
Table of Contents	iv	
List of Tables	v	
List of Figures	vi	
Chapter 1:	Introduction	1
1.0 Introduction	1	
1.1 Context and Background	1	
1.2 Issues	3	
1.3 Research Focus	4	
Chapter 2:	Literature Review	5
2.0 Introduction	5	
2.1 Information Communication Technology in Schools	5	
2.2 Teachers' Use of ICTs	19	
2.3 ICT Professional Development Programme	26	
2.4 Summary	32	
Chapter 3:	Methodology	33
3.0 Introduction	33	
3.1 Research Questions	33	
3.2 Methodology	34	
3.3 Research Methods	35	
3.4 Methods of Data Generation and Collection	37	
3.5 Ethical Considerations and Access	42	
3.6 Research Design and Role of the Research	44	
3.7 Data Analysis	51	
3.8 Summary	54	

Chapter 4:	Results and Findings	55
4.0 Introduction		55
4.1 Teachers' Current Use of ICT		56
4.2 Professional Development		74
4.3 Beliefs about ICT		85
4.4 Summary		93
Chapter 5:	Discussion	95
5.0 Introduction		95
5.1 Current use of ICT		95
5.2 Professional Development		104
5.3 Teachers' Beliefs about ICT		109
5.4 Summary		112
Chapter 6:	Conclusion	115
6.0 Introduction		115
6.1 Conclusion		115
6.2 Recommendations		116
6.3 Limitations of Research		118
6.4 Suggestions for Further Research		119
References		120
Appendices		127
Appendix 1	Questionnaire	128
Appendix 2	Approval from the General Manager of Girls	137
Appendix 3	Approval from the General Manager of Boys	139
Appendix 4	Invitation Letter to take part	141
Appendix 5	Information Consent	143
Appendix 6	Withdrawal Form	144
Appendix 7	Administrators Consent Form for Questionnaire	145
Appendix 8	Help Sheet	146
Appendix 9	Instructions for Participants	147

LIST OF TABLES

3.1	Questionnaire Methods	48
3.2	Cronbach values of questionnaire sections	53
4.1	Sample profile	55
4.2	Participants rating of their ability to use ICT tools	57
4.3	Number of teachers have personal computers	57
4.4	Period of years that teachers owned their Personal computer	57
4.5	ICT Tools available in Schools	58
4.6	ICT Tools available in rented schools and Aramco schools	59
4.7	ICT Tools most used in schools	61
4.8	How often teachers use ICT tools	63
4.9	Applications of ICT use	64
4.10	Reasons: For teachers who used specific ICT tools	69
4.11	Frequency of teachers' use of activities	73
4.12	Barriers that Teachers have encountered	80
4.13	Rating of Teachers' Agreement to beliefs about ICT	86
4.14	Rating of Teachers' Agreement with Teaching by ICT	87
4.15	Rating of Teachers' Agreement with PD for ICT	89
4.16	Rating of Teachers' Agreement of Barriers to ICT	90
4.17	Most Valuable ICT Tools for Science Teachers	90
4.18	Teachers Responses to the importance of teachers' improvement in ICT	91
4.19	Teachers Responses to the importance of students' improvement from ICT	91
4.20	Teachers Responses to the importance of access to the Internet	92
4.21	Teachers Responses to the importance of other elements of ICT	92

LIST OF FIGURES

3.1	Stages in the planning of a survey	49
4.1	ICT tools that were available in schools	60
4.2	ICT tools most used in schools	62
4.3	Teachers' use of ICT for administration	65
4.4	Teachers' use of ICT for communication	65
4.5	Teachers' use of ICT for lesson planning and preparation	66
4.6	Teachers' use of ICT in the classroom	67
4.7	Teachers' use of ICT for evaluation and assessment	68
4.8	Teachers' ways of learning how to use ICT tools	74

CHAPTER 1

INTRODUCTION

1.0 Introduction

This study focuses on the Saudi Arabia context. Background information for this research is provided in the three main chosen areas has been illustrated under the subheadings of Context and Background; Issues and Research Focus.

1.1 Context and Background

In Saudi Arabia, the Ministry of Education is responsible for all other ministries in all the different cities. It distributes funds to each ministry, depending on its size, which is relative to how many schools belong in each ministry's district. Girls' and boys' ministries are separated. In both girls' and boys' ministries there are different types of schools, such as Aramco Company schools (which are usually expected to have a high quality of resources and an ongoing maintenance of buildings and of the resources as well), public schools, and small schools in rented premises. Private schools are not part of this study.

In 2007, there was a big project by King Abdul Abdullah Bin Abdul Aziz for the development of public education. The Ministry of Education in Saudi Arabia identified thirty-nine steps to implement this project which includes curriculum development, professional development programmes for teachers, improvement of the educational environment and the extra-curricular activities for students of the more than five million students (Ministry of Education, 2007). The implementation of this project required the preparation of curricula, digital electronic books and educational elements of the curriculum, and building technical standards integration into the curriculum, curriculum development at all stages, starting in kindergarten through to secondary school. The cost of implementation was 11 billion riyals (USD 293 million).

The Ministry also identified nine steps to improve the educational environment including linking all schools through high-speed digital communication and

providing networks within schools with the necessary server, and providing portable PC (laptop) devices to each teacher for preparation and lessons.

Throughout 2007, the Ministry was in the process of identifying the numbers of teachers, and grouping them into their teaching subject areas, so as to identify training needs, and to set standards for quality control and performance, for professional development (PD) programmes. The professional development programmes are to train teachers so that they become qualified to teach generations of students who are capable of high levels of understanding, comprehension, development and innovation.

Amongst the PD teachers' programmes, there is a particular PD initiative focusing on teachers' use of ICT tools. The programme aims to provide professional development programmes for teachers through courses to improve their educational abilities in teaching in their specialties; develop their teaching and leadership in the light of the concept of competencies, skills and contemporary changes; and make training an interactive, continuous process. It also aims to provide teachers with skills and expertise in the area of ICT to enable them to be employed in the fields of teaching, and to develop positive attitudes and promote the spirit of belonging and loyalty to the homeland and to the teaching profession (Ministry of Education, 2007).

The Saudi government's goal is to blend ICT with education (Ministry of Education, 2007). Consequently, the Computer Based Labs project has been established in schools across a range of different technologies. Along with this, and proceeding from the importance of student exercises in scientific experiments, (Hands-on Activities) the intention was to provide schools with new labs which included high technological devices such electronic microscopes and other ICT tools to give students the opportunity to examine, observe and investigate.

1.2 Issues

The Saudi government's goal is to blend ICT with education. Al-Otaibi (2006) in his study in Saudi, noted that teachers could not use ICT tools for e-learning. He found that the existing curricula did not easily fit with e-learning. He also found that there was a lack of information for teachers to support e-learning. Other barriers to successful uptake of e-learning included the high numbers of students per class, the limited number of computers in schools, a lack of suitable places for e-learning, and a shortage of trained e-learning teachers.

Al-Otaibi (2006) also added that female teachers were less outspoken about their computer use, since many of them had not been to training courses on e-education. They also mentioned that they had less time for e-learning training because they spent most of their free time raising their children, rather than attending training courses.

When I was a supervisor in the Education Technologies Department between 2000 and 2005, I visited schools as an advisor on ICT tools. Like Al-Otaibi, (2006) I also noticed that there were some science teachers who were aware of the benefits of using ICT technologies that had been provided for them and they had integrated them into their classroom programmes. However, I also noticed that others had not, for various reasons. For instance, I noticed they had a lack of motivation, there was little or no encouragement from principals, and there was a lack of formal training.

In the past five years, I have been involved with the education technologies management in Dammam as technology trainer. The education technologies management has provided information communication technology (ICT) tools to schools, across primary, intermediate and secondary schools in the Eastern district. These ICT tools are used in all curriculum areas as teaching aids and also to educate both teachers and students on how these devices are of great value in supporting teaching and learning. In contrast to male schools, female schools do not have full equipment for the (ICT) tools, because of the lack of supply.

These ICT tools include computer lab networks, digital microscopes with sensors for science subjects such as chemistry and biology, data show/projectors, electronic whiteboards, digital cameras, audio visual devices and software to allow for distributed teaching amongst networked computers. In 2007, there was ongoing introduction of science specific ICT tools. More and more up-to-date equipment was being introduced into science teaching classrooms. At the same time, through professional development programmes held in individual schools, we trained some teachers on how they could use these ICT tools. However, many science teachers did not undertake PD and appeared to have difficulties incorporating these science specific ICT tools into their classroom programmes. I was therefore, interested in finding out about science teachers' current use of specialist science ICT tools.

1.3 Research Focus

This study will investigate Saudi science secondary school teachers' current use of ICT, their current beliefs about the benefits of ICT, how ICT has changed what they have done, the impact of the use of ICT on teacher-student interactions, and what they perceive their needs are for improving ICT use in the classrooms.

The purpose of this research project is to investigate Provincial Saudi Science Secondary School Teachers' Perceptions of the use of ICT tools to support teaching and learning. It is expected that the results of the research will guide future research and development in the country and outline the importance of the use of information and communication technology in education for teachers, students, parents and decision-makers. It will contribute information towards decision-making and planning in future projects.

Chapter 2 following which is the literature review. Research literature from Saudi sources will be explored where available.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

With the revolution of technology in this age of globalization, many countries tend to maximize the use of information communication technology (ICT) in their educational institutions. Many ICT tools have been introduced into schools and more and more up-to-date equipment is beginning to be introduced into science teaching classrooms.

There are many reasons for incorporating advanced ICT tools in schools and colleges. This is because technical literacy will be a key factor and condition for employment in the future. Today, for example, most jobs require knowledge of information communication technology (Irving, 1999). There is no doubt that high speed improvements that have emerged over the last twenty years in ICT will require that everyone in future societies will have at least the basic skills required to use ICT.

This study focuses on a Saudi Arabia context and accordingly, research literature from Saudi sources will be explored where available. This review will look at literature on ICT in schools, teachers use of ICT, and ICT professional development.

2.1 Information Communication Technology in Schools

This section will define ICT; explain its importance in education and in particular the integration of ICT and the benefits in science education.

Definition of information communication technology (ICT)

Confusion and misunderstandings in relation to the meaning of ICT and Technology have always prevailed among educators, as some of them assume that ICT is a technology and others think that technology is a part of ICT. Layton (1994) has indicated that the ICT area is one of the seven essential learning areas of study: electronics and control, biotechnology, food technology, materials technology, structure and mechanisms, and production and process technology.

This study will define Information and Communications Technology (ICT) as:

An umbrella term that includes any communication device or application, encompassing: radio, television, cellular phones, computer and network hardware and software, satellite systems and so on, as well as the various services and applications associated with them, such as videoconferencing and distance learning. ICTs will often be spoken of in a particular context, such as ICTs in education, health care, or libraries. (Tech Target, 2007, p.1)

From the definition above it is clearly apparent that ICT tools nowadays are considered to be of great value in supporting teaching, learning and improving teacher and student ability to use telecommunication to collaborate, publish, search information and interact with peers, experts and other audiences; all of the above preparing them for the e-learning environment which is dependent on ICT tools. This type of education has provided opportunities for learners to improve competency by using ICT tools. The definition below of e-learning is evidence that ICT tools are a fundamental component in the success of e-learning.

Criscito (2003) has defined E-learning as:

a type of education, typically college-level, where students work on their own at home or at the office and communicate with a faculty and other students via e-mail, electronic forums, videoconferencing, chat rooms, bulletin boards, instant messaging and other forms of computer-based communication. (p.1)

Actually, ICT, in all its forms, old or new, simple and complex, can be potent tools that engage teacher and learner in reflection and development. These tools enable learners to rethink their old beliefs, knowledge, and understanding. These tools might allow learners to compare new ideas with other individuals, to assess whether new concepts and ideas are plausible and might be fruitful. ICT can remove barriers that inhibit educators' ability to access information. Prahalad and Hart (2002) noted that the single biggest roadblock to sustainable development is information poverty and that is due to the lack of information literacy. So, to allow teachers and students to

seek information in the right way, teachers and learners should learn the skill of how to seek information as there is a huge range of information that needs to be organized, managed, and stored.

Dykes, (2002) in his study of information literacy to investigate the use of ICT in four New Zealand secondary schools, found that depending on the definitions of information literacy in their ICT goals, information literacy had been playing an imperative role. He defined it as:

a separate skill or a new approach to learning, [which] should be undertaken to enhance teachers'/students' skills of seeking information from digital resources. And also he noted that information literacy is a set of inquiry and research-based skills which enable students to critically analyse, assess and appreciate information and its relevance to their needs and how to narrow that down to information that they can apply to a particular set of studies or assignments. (p.26)

He added that “....introducing students to the Internet and getting them some skills there and expanding the idea of Boolean searches” (p.29) is also part of that set of skills. As the world changes at an ever-increasing rate and access to information proliferates, individuals need better ways of locating information and dealing effectively with it. Dykes (2002) concludes that the schools are being increasingly encouraged to integrate information literacy into their teaching and learning with ICT.

Importance of ICT in Education

Many countries in Europe have determined the importance of ICT and have integrated it into their schools during the last decade, and today it is becoming compulsory to use ICT in teaching and to integrate it into subject teaching (Balcon, 2003). No doubt, ICT tools such as interactive whiteboards, video projection units, digital microscopes, CD-ROMs, presentations with video, resources selected from the

Internet, prepared handouts for students and model data will continue to impact on education and these will have advantages for the teachers and students (Department for Education & Skills, 2004).

The Saudi Arabia government's goals are to blend ICT with education and improve the e-learning environment to cope with the new age of technology (Saudi's High Ministry of Education, 2006). ICT will enhance the way of teaching. It will open new opportunities for both science teachers and students to improve their knowledge, experience, and ability to investigate, explore, observe and undertake experiments effectively.

The following sections will demonstrate a range of reasons for the importance of ICT in education. Relevant perspectives and observations will be presented under the sub-headings of: saving time; communication and collaboration; and the acquisition of the material and learning opportunities for everyone.

Saving Time

An important aspect identified in the literature was that the use of ICT tools will help teachers and students to save time. Jacobson and Levin (1993) noted that teachers have a firm conviction that the use of the technology will help students in their education, and they concluded that the use of electronic mail, for example, in research and communication will help teachers and students to save time. Balanskat, Blamire, and Kefalla (2007) support Jacobson and Levin's position by emphasizing that most progress has been made in recent years in raising teachers' positive attitudes towards ICT by realizing its value for learning through more experience and embedded use. Teachers increasingly use ICT to prepare their work more efficiently and achieve time gains. In the latest Euro barometer benchmarking survey (September, 2006), 90% of teachers in Europe already use ICT to prepare their lessons.

Communication and Collaboration

Another advantage for using ICT in education is that using ICT tools correctly, in and out of the classroom, can increase communication and collaboration between teachers in and out of school, between teachers and students and between students and students moving away from the old “banking” way of teaching where information is only moved from teacher to students without any freedom for critical analysis on the part of the learner (Hawkins, 2002). In their research report *Digital Horizons: Laptops for Teachers’ Evaluations* Cowie, Jones, Harlow, McGee, Millar, Cooper and Gardiner (2008) found that ICT tools such as the laptop were supporting communication and the sharing of work between teachers and students in and out of class time. Students were said to be seeking to engage with teachers’ lesson materials in different ways and teachers were more easily able to share teaching notes and exemplary work with students via CD and email. Furthermore, teacher and student experiences have been improved when working around a computer or using ICT tools.

Furthermore, Earl (2002), in her study of Curriculum Innovation in a New Zealand Secondary School, added that ICT gave both teachers and students the opportunity to increase their communication and interaction with others whether in a school district or outside it, and also that the students’ knowledge improved relationships when they were working around a computer. Treagust and Rennie (1993) stated that with ICT tools teachers can communicate locally and globally with others to gain confidence and competence; to use the Internet networks to communicate and seek support from experts in ICT and to search in different websites and resources about ICT in education. Ryba (1992) identified that “students often appear to learn more from one another than they do from interacting with the computer on its own. It is what people do with the technology that determines its effectiveness in teaching and learning” (p.86).

Acquisition of Material and Learning Opportunities for Everyone

That secondary school students are better acquainted with today's computers is a primary reason to use ICT tools.

Tasar, (2006) in her review of *ICT Fluency and High Schools: A Workshop Summary*, noted that "... ICT has great importance especially in secondary education and takes place in many curricula starting from elementary school years" (p.94). She added that secondary school students are better acquainted with today's computers and ICT than their teachers, because they were born directly into this technology. The influence of ICT in education has changed teacher and student attitudes toward the use of ICT. Most students who have become highly familiar with ICT outside the school environment and have more experience than their teachers, have encouraged their teachers to change the way of teaching and to improve their skills in ICT use. ICT use applies not only to enhanced achievement, but also makes learning more enjoyable. Moreover, there is clear evidence that ICT improves learners' perceptions of their accomplishment, therefore building confidence and encouraging future learning (Becta, 2006). For this reason, it was emphasized that teachers would be appreciative of a change in their attitudes and move towards self proficiency in order to encourage ICT confidence in their students. Therefore, ICT education for teachers has become critically important.

ICT has provided teachers with many chances to improve the quality of data available to students. It allows teachers to develop data handling using spreadsheets and graphing software to analyse data and perform research. It helps with lesson planning by using the Internet browsers, multimedia CD ROMs, developing science lessons by designing informative PowerPoint s, Web pages, flash animations, and digital video productions and also allows teachers to create interactive learning modules. Denby and Campbell (2005) go farther and add that:

ICT can improve the quality of data available to students. Information gleaned from the Internet can be more up to date, and data obtained from loggers can

provide more frequent and more accurate experimental readings; computers allow repetitive tasks to be carried out quickly and accurately so that more student time can be spent on thinking about the scientific data that has been generated; ICT can extend learning beyond the constraints of a traditional teaching space. (p.4)

They added that ICT gave opportunities for both teachers and students to do their job and to be creative whether they are in school or at home.

However, teaching by using ICT tools needs to be followed up with the new technologies. All students should benefit and take full advantage of the opportunities that ICT provides. Different tools should be available in adequate numbers and variety in each school including both hardware and software (Mikis, 2004).

Nowadays, there are many countries that have recognised the importance of the ICT tools in education and the changes this will bring in the ways of teaching and learning. The improvements in education nowadays as a result of using ICT and integrating ICT tools in education have attracted the attention of many countries to the change and implementation of the different forms of education delivery. Downes (1998) noted that education will become much less class-based, and much more topic-based. This is already the model being explored by such alternative educational models as programmed learning and constructive learning. The idea is that learning is not paced so much by the teacher as it is by the student's own capacity to acquire the material. Additionally, the topic selection for an individual's education will be based on that student's need, not the preselected curriculum for a particular class. Any given student may at any time be taking any given topic, and progressing at a pace through that material appropriate to his or her learning ability.

Actually, the new era of information has brought with it a new paradigm of schooling. Haddad and Draxler (2002) explained that the traditional concept of school will change to a new paradigm, which includes a knowledge infrastructure (schools,

labs, radio, television, Internet, museums...) instead of a school building, individual learners instead of classrooms, a teacher (as a tutor and facilitator) instead of a teacher (as provider of knowledge) and ICT tools (print, audio, video, digital camera...) instead of a set of textbooks and some audiovisual aids. They further note that “education will not be a location anymore, but an activity: a teaching/learning activity” (p.8).

From the above it is clearly evidenced that ICT tools are the key factor to our future. The Internet for example, is a portal, a window to the world, speaking the languages of the world and playing all the desired services, and it is an integral part of today's world. Through the Internet, information retrieval will become easier as more specifically targeted searches can be performed and a greater awareness of e-learning will be created. Learning opportunities for everyone will become more accessible and fun for all students, teachers, parents, schools, library users, employees, etc. For instance, the Saudi Arabian government's goals are to blend ICT with education and improve the e-learning environment to cope with the new age of technology. What distinguishes e-learning is the technological infrastructure which is a basis for this type of education (Saudi's Ministry of Higher Education, 2006). Butcher (2003) indicated that having the technological infrastructure is a necessary condition for access to ICT.

Furthermore, Lau (2002) noted that in e-learning there are opportunities provided for the e-teachers to build in video or audio presentations of themselves to enhance their presence to distributed learners. They can use e-mail, electronic forums, videoconferencing, chat rooms, bulletin boards, instant messaging and other forms of computer-based communication.

The open education era developments, particularly in the area of ICT, will facilitate the educational process and make it accessible without obstacles impeding for instance, the time or the place or the cost. This is the fundamental difference, this pattern to determine education from the wishes of the student as they seek new ways

of learning using new technologies, ICT. They will learn to cope with what is happening around them in the revolution of ICT and to remove obstacles and open outlets so that knowledge becomes more expansive. The open education pattern is very much more flexible in time, place and cost, through the employment of modern technologies in networking knowledge (Saudi's Ministry of Higher Education, 2006).

With the rapid growth and potential usage of ICT as a learning tool, teachers are now being challenged by how to avoid reinventing strategies for ICT use (Balanskat et al., 2007). How teachers can share stories and resources among themselves is also another challenge. By sharing ideas and experiences of ICT successes and failures, teachers can break the barriers of the isolated classroom and develop a culture of collective knowledge. In addition, they noted that the majority of the teachers are still at the stage of using ICT to improve existing educational practice. They added that “current pedagogy is subject-centred, and uses ICT for differentiation and project-based teaching in more advanced cases. Furthermore, collaboration between students is not yet sufficiently exploited” (p. 57).

Within teacher-communities there appears to be a variety of inhibiting elements affecting the consistent and sustained use of ICT in their teaching environments. This reluctance is particularly notable in Saudi Arabia, perhaps due to a lack of understanding by science teachers of the importance of ICT in the learning process.

Barriers to using ICT Tools

There are many barriers that could inhibit teachers in their use of ICT tools in the classroom. Cowie et al. (2008) noted that there are some teachers who do not yet believe in exploiting ICT to support new approaches in teaching. Earl (2002) has contributed on that point by saying that teachers need to develop sympathetic definitions of ICT and a consciousness that ICT solutions do not always benefit everyone. They may not be aware how important ICT is for education.

In his study on obstacles to e-learning in Saudi Arabia, Al-Otaibi (2006) noted that teachers avoided using ICT tools for e-learning. This was because the existing curricula and the context did not easily fit with e-learning. He found that there was a lack of information for teachers to support e-learning. Other barriers to successful uptake of e-learning included the high numbers of students per class, the limited number of computers in schools, a lack of suitable places for e-learning, and a shortage of trained e-learning teachers.

Al-Otaibi also added that female teachers were less candid about their computer use, since many of them had not been to training courses on e-education. They also mentioned that they had less time for e-learning training because they spent most of their free time raising their own children, in preference to attending training courses.

Furthermore, Balanskat et al. (2007) go farther by identifying that there are a variety of boundaries, such as, the lack of ICT skills, that could limit teachers in using ICT tools. Also, there is a reluctance in many teachers towards the use of ICT. Many of them did not want to increase their personal burden for reasons of old age and lack of desire to displace conventional methods, as well as a fear of wasting time by using technical means. Of particular significance, they point out the lack of incentives and encouragement from those responsible for the promotion of ICT. In particular, a lack of interest and disregard of infrastructure requirements of ICT from decision-makers. Also they observed that teachers had various negative attitudes to the change process and a general lack of understanding that the process had the potential to lead to better learning conditions.

To sum up, developing new and more robust ICT practices and activities is an objective for all teachers if they are trying to implement new technology ideas. Many teachers might have attended professional development programmes. However, these programs might not have been very effective because they may have attended without being aware of the outcomes sought; the main objective being, for them to understand the information learned from their professional development activities and to

implement those ideas in the classroom. Some teachers who have attended professional development programmes are enthusiastic and eager to implement new ideas and strategies. However, they may fail to effectively implement those new ICT ideas due to a lack of support from, and collaboration with, other teachers. Accordingly, they may feel isolated and somewhat despondent. Furthermore, there may well be a lack of motivation and encouragement from school managers and Ministries, impacting on a teacher's confidence in trying out new ideas in their classroom (Balanskat et al., 2007). Most significantly, Bell and Gilbert (1994) make sound observations on issues of time in relation to professional development formats. They comment (by implication) that the concept of professional development within a framework of one-day, one-shot approach does not bring about change and that developmental time is essential. Furthermore, they observe that professional development sessions "could not be neatly orchestrated within the tight time-lines of some administrators wanting to implement new policies" (p.496).

ICT Integration in a Science Education

Dawson, Forster and Reid, (2006) noted that nowadays in Australia, ICT has become the most important instrument to be integrated in secondary schools, as ICTs have been integrated in all subjects to enhance all teaching and learning. They added that "Nationally, all schools in Australian systems are in the process of providing teachers with computers and there is an expectation that new teachers will possess the expertise to use them in their teaching" (p.345). Consequently, their ability to use ICT will improve, their ways of teaching will change, and they will be able to add value to their science subjects.

Science education has changed from stage to stage and that change-process is still ongoing in order to enhance teaching and learning. In recent years, the purpose, nature and role of science education in society has been considerable. For instance, in the UK, that change took place when science education became a compulsory element of all children's education (Osborne & Hennessy, 2003).

In the past, the impact of ICT on science education was not as significant as it is today as the hardware, software and training were limited. On the other hand, in recent years, the high cost of the hardware that limited the application of ICT has fallen and the skills of teachers have improved. Science teachers now tend to use opportunities to develop strategies for using ICT in science.

Additionally, science as a vehicle has altered and students now use ICT skills as tools to assist learning in science. Students have learned the ICT skills in their own study environment and they have brought these skills to science classes in order to help their understanding and enjoyment of science (Denby & Campbell, 2005).

Science teachers in the past were using simple materials that were available for them to teach their subjects or to do their experiments. For example, the process of doing an experiment needed the students to go to the laboratory and wait for their teacher who needed to prepare the experiment materials before he/she could demonstrate it for them. However, ICT can provide extensive opportunities to develop science subjects and add value to teaching and learning (Department for Education & Skills, 2004). Nowadays, integrated ICT tools in science subjects has enhanced and simplified that process. The teachers can create the experiment with their students by using the computer. Biology teachers for instance, can use a digital microscope to observe samples and check specimens, and use sensors to measure physical change (e.g. temperature). Chemistry teachers can witness a micro-explosion in an experimental format with the benefit of ICT.

The Saudi government's goal is to blend ICT with education (Ministry of Education, 2007). Consequently, the Computer Based Labs project has been established in schools across a range of different technologies. Along with this, and proceeding from the importance of student exercises in scientific experiments, (Hands-on Activities), the intention was to provide schools with new labs which included advanced technological devices such electronic microscopes and other ICT tools to give students the opportunity to examine, observe and investigate.

Benefits of ICT in science

In her study (2002) of *Curriculum Innovation in A New Zealand Secondary School*, Earl noted that using ICT in different activities that simulated the “real world” had given students opportunities to increase their motivation and improve their attitudes toward the subject and their interest in learning. Activities like using a digital microscope to conduct experiments in science and check specimens; developing science lessons by designing informative PowerPoint, Web pages, flash animations, and digital video productions; creating web-quests (e.g. live Web conferences); providing lessons relevant to science subjects for all participants; and building the Internet into a lesson, could all increase the use of ICT and enhance teaching and learning.

Denby and Campbell, (2005) in their study of ICT in Support of Science Education: A Practical User’s Guide, contributed to Earl’s position by identifying that the use of ICT in a science classroom had motivated both teachers and students, and the teaching and learning was impacted positively. When teachers use ICT tools correctly in their science subject, many interactive activities will appear for students to be involved with and their interest and attention span will increase. ICT tools are playing important roles in enhancing teaching and learning: they give opportunities for teachers to create/use new ways of teaching including a wide range of real materials. Teachers can modify them and they are used in different and effective ways (Denby & Campbell, 2005).

ICT can provide access to a huge range of resources that are of high quality and connected to scientific learning. There are comprehensive websites which include a wealth of resources including ideas and information: The Association for Science Education (ASE), The Institute of Biology (IOB), The Institute of Physics (IOP), and The Royal Society of Chemistry (RSC) (Denby & Campbell, 2005). Through this wealth of resources, teachers and students are able to communicate with each other to increase their knowledge, sharing ideas and attending online conferences with experts without needing to spend money on travel. In other words, through those resources,

the world comes into your hands. For instance, Nood (2007) (A science teacher in Argo Community High School in South Side Chicago in the United States), has designed and created a website for both science teachers and students which includes lecture, video demonstration and interactive assessment. In fact, the website that has been created was a successful e-learning environment for science teachers (www.sciencewithmrnoon.com) to enhance their teaching by simulating those lessons installed in this website. Nood added that there are free resources such as Moodle and The Collaboratory Project that enable any tech-savvy school district to easily create e-learning environments comparable to WebCT and Blackboard. Nood believed that the US Ministry of Education spent large amounts of money to equip a typical school with resources such as text books, work books, study guides, activities guide and other classroom items. He attempted to pilot programmes for science courses that could impact on the teaching and learning of science subjects. He suggested that the government should supply ICT materials to schools free over the Internet, to encourage teachers to create their own websites. That could easily change teachers' techniques and save billions of dollars that are definitely needed for the supply of up-to-date technologies in the classroom.

Bell and Gilbert (1994) emphasised that working with other teachers in the same subject area will increase knowledge and improve teaching. Furthermore, they point out that teachers need to talk about what they are doing in the classroom and be encouraged to communicate with others, as well as adapting their teaching roles. They added that teachers also needed to have feedback from students and progressive information measuring their student's learning outcomes. In some cases, the resources fill gaps where there are no good conventional alternatives, in other cases they complement existing resources. The multi-media resources available enable visualisation and manipulation of complex models, three-dimensional images and movement to enhance understanding of scientific ideas; however, in some cases ICT resources are less effective than conventional alternatives and do not add to learning.

In their research report *Digital Horizons: Laptops for teachers' evaluations*, Cowie et al. (2008) noted that the general attitude of science teachers was positive about the benefits of greater access to a range of multimedia resources, including those on educational and other websites and CD ROMs and copies of electronic materials given to them by colleagues. Furthermore, for these teachers, the laptop had become a portable office that could be transported easily between school and home. Teachers had become familiar with their laptop, and most preferred to prepare their lessons at school sharing and acquiring knowledge with their colleagues.

2.2 Teachers' Use of ICTs

Teachers

Most teachers nowadays seek new ways of teaching using new technological tools, ICT, in order to keep up with what is happening around them within the ICT revolution. Technologies have an impact on learning communities and how they function and these technologies offer new and faster ways of human communication. The new reality today is to use new technology to support our education.

It is now becoming fully self-evident that various ICT technologies have a significant impact on learning communities and how they function. As a result, the majority of teachers are constantly engaged in the challenges of applying these evolving technologies in order to cope with the exponential growth of these new tools. The reality today is to facilitate and encourage the transition from traditionally based servants of ICT.

Hamza and Alhalabi (1990) noted that "With the aid of technology, many teachers can take students beyond traditional curriculum limits, creating virtual environments for experimentation and exploration" (p.8). They added that while teachers should be aware of how technology might be used in the most appropriate manner, they should not become totally wedded to it, but continue to explore the interpersonal student/teacher relationships that form the basis of intuitive leaps of understanding.

Current use of ICT in the classroom

ICT tools are used in the classroom and in all curriculum areas as teaching aids and also to educate both teachers and students on how these devices are of great value in supporting teaching and learning. The current use of these tools shows that there are many types of ICT in use. This section focuses on what the literature does say on the current usage of ICT in the classroom, including the application of ICT in education. This includes the use of ICT for lesson preparation, administration, assessment and communication, as well as in the laboratory and the use of hardware and software resources.

Cowie et al. (2008) noted that the most common task that teachers used their laptop for in the classroom, was for presenting their lessons through the PowerPoint presentation even though the use of PowerPoint was not widespread. The percentage fluctuated as it started with just 17.0 percent and rose to a third (34.0%). They added that the access to data projector/digital projectors was the highest rate, as around three quarters (72 %) of the teachers used that. Cowie et al. go farther by indicating that science teachers who used their laptop prevalently in both physics and chemistry classes with applets and the animation programs believed that the way to make obvious practical experiments and illustrate the reaction and explosions as a real was the use of ICT tools.

Application of ICT in education

Changes within education relating to ICT, method and technique, have become obvious to all observers in recent years. Significantly, the blending of ICT into education has evolved to become a fundamental consideration for educators. Both teachers and students anticipate the promise of empowerment through applications of ICT in education as innovations impact at breath-taking speed and expand knowledge horizons and skills competency. ICT can be of great value for science teachers. With ICT, teachers are able to develop and enhance teaching and learning (Becta, 2008).

Teachers' use of ICTs for lesson preparation

Ham, Gilmore, Kachelhoffer, Morrow, Moeau and Wenmouth (2002) noted in their study, *What Makes for Effective Teacher Professional Development in ICT?* that teachers used ICT for lesson planning and preparation. They used ICT tools to search the Internet for lesson ideas, produce task sheets or tests using word processors or DTP Packages, and to record lessons or unit plans in packages such as 3D Achieve. Furthermore, teachers can use different activities in integrating ICT tools. Teachers are drawing on all the knowledge, skills, and ideas to create a dynamic science resource. Additionally, Cowie et al. (2008) noted that around three quarters of science teachers were using the laptop to prepare student handouts or worksheets and access the Internet.

Teachers' use of ICTs for administration

Science teachers should recognize that ICT is a valuable supporting tool for administration. They can use ICT to write student reports, to record student science grades, check student science lists and check school timetables and notices. Cowie et al. (2008) noted that the majority of science teachers were using ICT tools, such as laptop, for writing reports for parents, recording and checking student data.

Teachers' use of ICTs for assessment

The evaluation of any task is the primary factor of success. Feedback and reflection will improve knowledge, skills and the understanding of what has been done in the classroom to enhance learning experiences. Shulman (1987) maintained that: "The assessment of teachers in most states consists of some combination of basic-skills test, an examination of competence in subject matter, and observation in the classroom to ensure that certain aspects of general teaching behavior are present" (p.6).

Evaluation and assessment using ICT tools makes the tasks relatively easy and greatly enhances professional presentation. Teachers can motivate their students by creating interactive science tests, giving and getting immediate feedback to and from

students after exams and analysing data statistically (Nood, 2007). In their project, How do teachers use information and communication technology in Icelandic high schools in 2002? Matthiasdottir, Dal and Lefever (2002) further contributed to Nood's argument by determining that assessment using ICT has become an important part of the teaching and learning process. In addition, to electronic portfolios and essays written in electronic format, the application of ICT to the evaluation and assessment process has provided teachers with a wide variety of new opportunities. They added that teachers can use ICT for interactive feedback, formative assessment, summative assessment, and self-assessment.

Ofsted (2003) noted that assessment at any stage of education is very important in order to enhance teaching and learning, especially through the use of ICT tools. By using ICT in assessment, the pupils will be encouraged and motivated to do so in their personal study time, particularly when they see the feedback from teachers that clearly demonstrates the professional impact of ICT tools. They added that the main idea of evaluation was to confirm the understanding by the students of the 'new knowledge' conveyed in the assessment, as well as subsequently confirming that the student had successfully integrated and implemented the directives in ongoing task performance. Herein, we can see the obvious benefits that accrue to this process in the dexterous application of appropriate ICT tools. Ofsted further highlights the considerable benefits of ICT to the teacher. In particular, the ongoing improvement in refined focus and lesson planning as a direct result of the assessment feedback.

Teachers' use of ICTs for communication

There are many factors that may contribute to the successful use of ICT as tools in science subjects. The ability to use ICT tools will increase teachers' communication with others. The new technologies are the keys to the future. Teachers can contact colleagues via email, participate in online discussion lists, engage in the collaborative development of units and access the Internet for professional reading, subject association news, etc. The Internet, for example, is revolutionizing ways of work, play, and communication. With ICT tools teachers are able to establish new ways of

teaching. It is possible to do things differently or even to do entirely different things. With the rapid growth and potential usage of ICT as learning tools, it is not easy for teachers to avoid reinventing strategies for ICT use; it is a challenge for them. Gathering information, sharing stories and resources amongst teachers is another challenge as well. The barriers of the isolated classroom can be broken down by ideas and experiences of technology successes and failures and a culture of collective knowledge can be developed (Jonassen, Howland, Moore, & Marra, 2003).

Teachers' use of ICTs in the laboratory

ICT can be of great value in the laboratory. There are some schools who do not have enough space or where existing bench space is needed for practical work. Denby and Campbell (2005) noted that:

An alternative and often complementary approach to bringing ICT into the laboratory or science classroom is to install a whole class viewing system for electronic resources. The advantages of this approach are ICT can be used as an everyday, integral part of learning; the ‘teacher led’ style of teaching is one with which most teachers are familiar and comfortable; it is more cost effective than the use of class sets of laptop computers. (p. 5)

Use of hardware resources

There are many forms of ICT tools, both hardware and software, that can support science teachers in creating new ways of teaching which might increase the interaction between students in the classroom. In this section, specific examples will be used to illustrate types of use of ICT tools that blend into the science classroom and give students an enhanced uptake of ICT in science, as well as better learning outcomes.

Science teachers in Australia, for example, are provided with a range of ICT resources in the science classroom which include hardware such as digital cameras, data projectors, laptops, electronic overhead projectors, electronic whiteboards,

software such as interactive CDs, interactive applets, simulations, electronic portfolios self-based online modules and websites for students and teachers (Dawson et al., 2006). These resources are used to prepare curriculum materials, manipulate data for analysis and report assessment results.

Another example of the successful use of ICT hardware tools was provided by Paine (2001), namely, that using specific ICT tools in science education has given better results. For example, in the UK, over 4000 Intel digital microscopes were selected and distributed to high schools for the Science Year. The aim of that project was to bring science alive in the classroom and focus on how ICT can enhance teaching and learning. At the same time, a research study was undertaken by Becta (2006) to show how teachers can use ICT tools effectively with their subjects. Over 10000 lessons using ICT in science were evaluated by the Association for Science Education (ASE). He added that Science Year was focused on improving the teacher's ability in using ICT because there was a belief that ICT was used very well and it would motivate the younger students, allowing more experimentation, analysis and presentation of results in a format allowing pupils to excel. Furthermore, it would encourage teachers to benefit from the science materials on the Web. Through the Science Year website (www.scienceyear.com) teachers and students can go through different lessons and use them and integrate them into their classroom or even simulate them and perform their lessons. He concluded by saying that we still need ongoing provision of ICT equipment in our schools, like flexicams, dataloggers, colour printers, electronic whiteboards and even more digital microscopes as well as computers.

To successfully integrate ICT into the science curriculum, science teachers need to develop sound pedagogical skills and higher order thinking skills. "ICT is a resource for co-operative group learning, and a means of communication with the wider community" (Dawson et al., 2006, p.346).

ICT tools have become an essential factor in education to enhance teaching and learning. For example, Riccarton High School in New Zealand has adopted the idea

of merging ICT into education. They have recorded all the basic laboratory techniques and science experiments on video and added them into the school network so students can see them at any time (Education Gazette, 2002). In addition, using video clips as a tool in education has allowed students who were ill or absent to catch up in their own time. Additionally, electricity and chemical modelling can be introduced using Web applications such as Java to demonstrate things that students cannot physically see.

The ICT tools introduced to the school, particularly into the science classroom, have attracted teachers to become involved in different activities. With appropriate pre-planning, teachers can make use of these tools. There is no doubt that through ICT tools, teacher-student interaction has increased significantly in the classroom and the laboratory (Bell, 2002). Tools such as interactive whiteboards have not only allowed educators to share ideas and information with large or small groups of students, but also to share learning experiences for distance learning. He added that all ages of students react positively to board use, and teachers have reported success with the youngest learners through to students in academic settings. Library science students, for example, have been extremely satisfied with such technology. Bell goes further by noting that users can contribute directly by input both at the computer and at the board. The combination that he liked best was for the teacher to be stationed at the computer, with students at the board offering suggestions and physically contributing ideas and action. The best interaction that became apparent involved the teacher at the computer and the learner at the board. He concluded that “the interactive white board is more than a toy or gimmick; with appropriate planning, preparation and training, it is a powerful instructional tool, which can be adapted for use with a wide range of subjects and ages” (p.3).

Use of software resources

There is an expectation that science teachers will be able to effectively use a range of ICT software related resources in the science classroom in order to enhance student learning. No one can deny the benefit that science teachers can gain when they use

ICT software. For instance, the use of ICT for teaching and learning was a main concern for Riccarton High School in Christchurch, New Zealand. Here, the Intranet was developing to become well established and available for all. They used Microsoft's Encarta Class Server Programme as a set of tools that allows teachers to work with students, parents and other teachers over the Internet and the school network (Education Gazette, 2002).

Another integration of ICT has been provided by the same school. They created a home page for students through which they can view and complete their assignments. This home page also enabled assignment marking and returns to the students. In addition, assignments such as multi-choice tests can be automatically marked and the results recorded on a spreadsheet. Principal Warburton says that "For critical, summative assessment we obviously can't use this technique but for formative assessment it's quite good" (p.3).

2.3 ICT Professional Development Programme (ICTPD)

ICT professional development is essential to the discovery of new ways of teaching and to bringing about positive changes to the education system, to encourage new ways of thinking, to implement new ideas in science classrooms, and to encourage teachers and students to continue development. Teachers as individuals may make many attempts to develop their own teaching skills and methods in using ICT by attending courses, workshops and specialized training. Along with that, teachers are considered to be a main factor for the educational change being successful. Earl (2002) explained that this is because their efforts, thinking and beliefs about teaching and learning were put into practice when they teach the students in the classroom. Scott (2000) has indicated that "In education, the most crucial leaders for change are the teachers who have the final say in whether a great idea is actually put into practice in a way that works for students" (p.8).

However, they may not be able to use the new ideas and techniques which they have learned in their self-development activities to improve the learning process and skills

of their students. They may find themselves teaching in the same way they always have. These teachers need to be supported and encouraged by their schools to change their teaching methodology and techniques (Balanskat et al., 2007). This section will discuss the importance of ICT professional development in education, successful professional development and barriers to change.

Nowadays, ICT major professional development programs have been initiated in Saudi Arabia (Ministry of Education, 2007). This plan has included teacher training through group training programmes and online training programmes, and one of these programmes is the draft of Information Technology and Communication in the Teaching of Science and Mathematics in Secondary Schools. The Ministry of Education and UNESCO, and a number of local and regional organizations, from both international and private sectors in Saudi Arabia, participated in the financing of this project. In addition, it encouraged teachers and motivated them by providing incentives to get their International Computer Driving License (ICDL), and Teachers Computer Driving License (TCDL) through the accredited companies (Ministry of Education, 2003).

Jones, Mather and Carr, (1994) noted that most important need for successful professional development, is to acknowledge, incorporate and address teachers' prior ideas, beliefs, experiences, concerns, interests and feelings. For PD to be successful in the technology classroom, teachers need to develop appropriate ICT activities in the classroom. Teachers also require positive attitudes to the change process and need to understand that process as potentially leading to better learning conditions. For professional development to work effectively, such programs need to develop a "metacognitive awareness" (Bell & Gilbert, 1994, p. 496) through the practice of reflecting on and evaluating the teacher's own learning processes. This is a very relevant factor impacting on teacher change through professional development.

McCarney (2004) in his study of effective models of staff development in ICT, noted that the successful use of ICT is dependent on different factors, the main factor being

that of understanding the pedagogy of using ICT as a teaching tool. Unfortunately, the majority of educational institutions were focusing on ICT tools, and how they can blend them with their education, how they can enhance students' learning using these tools, and how they prepare both teachers and students for future's ICT. On the other hand, they were ignoring the importance of curriculum content and the process of learning; ignoring the pedagogic concept of blending technology with education, and the reasons for using ICT. If they were to understand the more holistic benefits of using ICT tools in education, maybe they would not need to make such enormous changes each time a new technology comes along. Kukulska-Hulme (2005) contributed on that point, and pointed out that in most cases the reasons for using mobile technologies are to improve access, evaluate and enhance learning, evaluate and enhance teaching, explore learners' requirements and behaviours, and align with institutional or business aims. The important thing with any technology is to understand that technology very well, and then you can adapt this technology to your aims. In order for teachers to change teaching methods and incorporate technology, they must have time, confidence, motivation, training, the proper mobile technology supported environment and the incentive to do so. Therefore, teachers should recognize that changing from traditional ways of teaching to the new ways of ICT is a self-education process and although well supported professionally, will not be easy.

McKenzie (1998) noted that ICT in the classroom has taken time, around twenty years in fact. He added that the reason was because there was little support for teachers' professional development in this area. Cox, Preston, and Cox (1999) have recognized a number of external aspects that will manipulate how teachers move toward this change: the requirement for a national curriculum or guidelines; ICT requirement for new teachers; new opportunities; funded training for teachers; changes in society with rapid growth in ICT use; school policies on ICT; opinions of colleagues and peer pressure; responsibilities of the teacher; pressure from parents and pupils; and the influence and policies of the education authority.

So, greater awareness from a wider range of society, students, parents, teachers and governments of the importance of ICT use in education should be developed. Interest from governments to build technical infrastructures in educational institutions should also be undertaken, as well as initiatives and alternatives outside school. Universities, institutions, and schools need to accommodate the changes and challenges of ICT by putting in place all the new technologies, such as computer labs, networking between classes, and making sure that each class has a laptop for the teacher connecting with projector and printer, so he can use them while he is teaching.

Additionally to this, Earl (2002) noted that teaching methods involving ICT use in the classroom need to be evaluated. No doubt, that evaluation of any task is a factor of success. Feedback and reflection will improve knowledge, skill and the understanding of what has been done in the classroom to enhance learning experiences.

The developed countries, such as the United Kingdom, are trying to develop new models that will integrate ICT tools in education to educate the population and workforce. The overall objective is to enable students to become familiar, confident and technically experienced in the use of such technologies. Teachers must be fully experienced and confident in the pedagogy of using ICT, therefore, staff development is essential for these teachers.

Along with this, the UK government's education policy is to ensure that all teachers, students and parents can access ICT, the Internet and e-learning to allow them to increase their use of ICT forms from home. However, the government is not sure if that will help teachers to integrate those skills in the classroom and assist them in their work. Consequently, the government was trying to develop a massive source of learning materials that would be available from a computer based in the school, laboratory, library community centre, university, college, workforce, home, etc. The government's intention is based on an information society and e-learning being available to the whole population, which will require training and development. This teaching focus is on the applications of ICT in the classroom rather than the technical

skills of using ICT. McCarney (2004) concluded by indicating that the teachers more often than not benefit from staff development activities that happen outside the school as these take them away from their own restricted situation and allow them to meet peers on “new turf” and to engage in professional conversation and discussion.

Successful professional development

Successful professional development required in ICT is challenged by several goals that require significant deliberation and planning before implementation: ensuring competency in the skill-sets required to operate both hardware and software; enabling progressive transition from PD learning into the classroom on a daily basis; and the creation of a new intellectual environment where in teachers understanding of PD can be encouraged to challenge their traditional methodologies in the light of the new insights that PD will provide them with.

Compton and Jones (1998) go further and argue that successful professional development needs to focus on how ICT/technology can become a part of the school, classroom and curriculum. “This must be based on a sound pedagogy in keeping with the concept of technology education,” (p. 165). The teachers need to understand the importance of blending ICT/technology with education. The goal of blending ICT/technology with education is to encourage all teachers in schools to start using the equipment of ICT, in particular, integrally in their day-to-day teaching. Using ICT as a part of the curriculum and as a teaching aid will serve to educate both teachers and students on how these technologies can be used to enhance learning.

Professional development is essential to the discovery of new ways of teaching and to bringing about positive changes to the education system. Irving (1999) has noted that “Today, that road of discovery is a highway of light and speed to connect the traditional with the new across the spectrum of professional development in technology education” (p.5). The technology has played an important role in education. It can be a great tool that involves teachers in reflection and development. The ICT tools require teachers to review their position on old beliefs, knowledge and

understanding. These tools might allow the comparison of new ideas with other individuals to assess whether new concepts and ideas are plausible and might be fruitful (Hamza & Alhalabi, 1990).

Williams, Coles, Wilson, Richardson, and Tuson (2002), in their study, Teachers and ICT, noted that teachers were still in an early stage of ICT development. To be coping with those new technologies, skills and knowledge are required. No doubt that is the key to the effective implementation of ICT in teaching and learning. They added that teachers need the training which is relevant in terms of content and timing so as to enable them to take advantage of the ICT which is becoming available in schools. They continued by adding that training needs to be supported by technicians who should be able to provide any help for teachers related to ICT. It is also very important that this group of staff continues to develop their own skills and knowledge. “A more holistic approach is required comprising appropriate training (appropriate in terms of skills, knowledge, relevance to educational goals and priorities, and delivery); ready access to ICT resources; and ongoing support and advice to encourage progression beyond any formal training” (Williams et al., 2002, p.319).

However, there are many limitations that could slow the wheel of ICT training and render much of its work ineffective. In this area, and of particular importance, is the quality of the PD tutor. Such individuals are presented with very challenging obstacles in the way of the efficacy of their task: ensuring the correct pace of delivery appropriate to the learning group’s stage of development; avoiding the over-use of jargon; providing too much information without the time for questions and reflection; and lastly, but by no means least, enabling and encouraging teachers to apply their learning progressively within the classroom (Williams et al., 2002). Great challenges indeed.

2.4 Summary

The literature review in this chapter suggests that ICT tools have the potential to enhance education, in particular science education. ICT, in all its forms, old or new, simple and complex, can provide potent tools that engage teacher and learner in reflection and development. These tools enable learners to rethink their old beliefs, knowledge, and understanding. They might allow learners to compare new ideas with other individuals, to assess whether new concepts and ideas are plausible and might be fruitful. ICT can remove barriers that inhibit educators' access information. Section 2.1 established the definition of ICT; explained the importance of ICT in education, particularly how to integrate these tools into classroom; the benefits in science education that can be gained and the barriers that might inhibit the use of these ICT tools. The discussion in Section 2.2 explored the potential of science teachers in the use of ICT in their classes; and the current use of ICT in the classroom. Finally, Section 2.3 looked further into the importance and impact of ICT Professional Development (ICTPD) on teachers' use of ICT tools to enhance teaching and learning.

The next chapter details the methodology and methods employed to research Saudi science secondary school teachers' current use of ICT, their beliefs about the benefits of ICT and what they perceive their needs are for improving ICT use in the classrooms. The chapter includes an ethical statement and profiles of the research participants' schools.

CHAPTER 3

METHODOLOGY

3.0 Introduction

The previous chapter introduced the literature review which was focused teachers' perceptions of the use of ICT tools to support teaching and learning. This chapter discusses the research design used in this research and details the methods used to collect data. Section 3.1 introduces the research questions. Section 3.2 presents the research paradigm. Section 3.3 discusses the research methods employed in this research. Section 3.4 describes the methods of data collection that were used. Section 3.5 explains ethical considerations and issues of access. Section 3.6 describes how the research was designed and conducted. Section 3.7 covers data analysis, and section 3.8 is a summary.

3.1 Research Questions

The purpose of the study was to investigate the beliefs and perceptions of Saudi secondary school science teachers concerning ICT. Accordingly, three questions were posed:

- 1) In what ways do Saudi secondary teachers use ICT?
- 2) In terms of ICT skills and knowledge, what do Saudi secondary school teachers think are their needs for improving the use of ICT use in the classroom?
- 3) What are Saudi secondary school teachers' current perceptions of ICT?

It is expected that the results of the research will serve to guide future research and development in Saudi Arabia. Furthermore, it is hoped that this research will contribute information towards decision-making and planning for future projects.

3.2 Methodology

Research Paradigm

This section will explain the interpretive paradigm, and why it was the appropriate choice for this research. In order to do this, the discussion will begin by defining a paradigm and describing the foundations of the normative paradigm. This will help to clarify an understanding of its alternative, the interpretive paradigm.

Awareness of different research paradigms and educational research methods is now of extreme importance to the advancement not only of education, but all theoretical and practical sciences. Identifying a research problem, describing the problem, choosing the method of collecting data and analysing the data are all essential processes in achieving the whole (Molhem, 2005).

A paradigm is a framework of a set of beliefs which guide actions (Denzin & Lincoln, 1998), so, it is important to outline not only the characteristics of the type of research, but the assumptions which lie behind it. Donmoyer (2006) contributes the point-of-view that the researcher should not be confined to one type of research, but should shift from one paradigm to another depending on the purpose of the research.

In their study, Cohen, Manion and Morrison (2005) gave a broad view of paradigm by defining it as a systematic way of thinking about the world, about knowledge, and by extension, about doing research. One of the many classifications of paradigm is that a paradigm is normative, a study of averages, or what usually happens dependent on two main orienting ideas: the first being about human behaviour and the second about investigation by the methods of natural science. However, a paradigm can alternatively be interpretive wherein the research approach studies the meanings that people give to their actions and behaviour. The interpretive paradigm attempts to understand the subjective world of human experience, to delve inside and understand a person's situation from within. The major intention is to understand and interpret the world in terms of its actors and heavy emphasis is laid upon meanings and interpretations. It is dependent on the investigation of individuals in order to

understand the subjective world of human experience, to go further in depth, to understand from within and to explore their interpretations of the world around them. Another approach is the critical educational research paradigm which considers the political and social effects on the participants of the situations studied (Cohen et al., 2005). This approach seeks not only to give an account of the behaviour of a society, but also to emancipate individuals and groups and to attain equality and freedom of individuals in a democratic society. For example, Donmoyer (2006) says that if the purpose of the research is to change a policy, then the researcher can use a critical paradigm because that will require the writing of a report for those who have commissioned the research. Interpretive research might then be most appropriate to demonstrate the need to change. A critical research paradigm might then best serve the need to make that change happen.

This research draws on the interpretive paradigm (Cohen & Manion, 1994), where the focus is on how people interpret and make sense of their world. From this interpretive perspective, the researcher set out to investigate the beliefs of Saudi secondary school science teachers, in relation to the benefits of ICT, their current use of ICT and what they perceive their needs to be for improving the use of ICT in the classroom.

3.3 Research Methods

Method and methodology are not considered the same in educational research. Methodology refers to the research paradigm that guides the whole research project while method refers to the technique employed in obtaining and interpreting data (Lather, 1992; Guba & Lincoln, 1994).

In any research activity, the researcher's aim is to find out something about something (Robson, 2002). This can be done in different ways, by using different methods of gathering data. Depending on the objective of the research, the researcher should ask which method might be most appropriate for research. Research data can be collected by such methods as observation, interviewing, and surveying. The researcher should choose the most appropriate method for the problem he/she is

trying to clarify or question. Cohen et al. (2005) mentioned that the researcher has also to be aware of how to design research. Many questions need to be addressed and thoughtfully considered before starting the research. Such questions as:

What is the nature of the research? For whom is it being prepared?

Who will be the audience? What might be the socio-literacy profile of participants? What will be the most suitable mix of paradigms? These questions and many more are critical to the process of research design.

(Cohen et al. 2005, p.89)

This study surveys participants' beliefs and practice using a questionnaire. Fowler (1998) in his study of design and evaluation of survey questions, observed that the researcher should be aware of hypothetical questions and that questions should be carefully worded and asked one at a time. He continued by adding that pre-survey evaluation questions require group discussions to examine and critique the questions before finalisation. Also, he endorsed intensive individual interviews in order to assess the respondent's understanding of the questions. He concluded that in-field pre-testing it is important to select fifteen to thirty five interviewees of similar profiles to the respondents in the planned survey. Cohen et al. (2005) support Fowler's position by emphasizing that the framework of the research planning needs very careful consideration. They further point out that the quality of the final research will be dependent on the different strategies designed into the sampling, and that the sample will in turn depend upon the selected research method.

In broad terms, researchers use surveys to describe the attitudes, opinions, behaviours or characteristics of a group. They are typically administered in one of two ways: either at a moment in time over a cross section of a population, or over a length of time with the same population. This latter method is often used to determine changes of opinion or to identify trends, while in cross-sectional research, the intention is sometimes to describe current practice or to evaluate a programme or activity in which the participants have been involved. For this study the survey was administered over a cross section of a population at a moment in time.

3.4 Methods of Data Generation and Collection

Questionnaire

One of the most common techniques for undertaking a survey to collect data is the questionnaire. There is no all-encompassing rule as to when to use a questionnaire. The choice will be made based on a variety of factors including the type of information to be gathered and the available resources for the survey.

Rojas and Serpa (2005) defined a questionnaire as a tool for collecting information to describe, compare, or explain knowledge, attitudes, behaviours, and/or socio-demographic characteristics of a particular target group.

Cohen et al. (2005) noted that a questionnaire is an extensively used tool for gathering survey data and the surveys may be categorized into three groups: face-to-face, telephone and mail surveys. The selection of the type of survey often depends on where the selected respondents are located, with regard to achieving an adequate number of responses across a specific time period, the background of the participants and budget.

Questionnaire design

Following the guidelines provided by Molhem (2005), the research questions were formulated on the following principles: use complete sentences to avoid abbreviations and two-edged questions, and avoid negative questions and the adaptation of questions used successfully in other questionnaires. Cohen et al. (2005) emphasize that the questionnaire should also avoid leading questions, highbrow questions, complex questions, irritating questions, questions that use negatives and double negatives, and the avoidance of open-ended questions on self-completion questionnaires, as such questionnaires cannot probe respondents to refine what is meant by particular responses. Open-ended questions in this format are a less satisfactory way of eliciting information. Consideration of all of the forgoing was applied to the formulation of questions for this questionnaire.

Cohen et al. (2005) say "it is important to pilot and pre-pilot a survey. The difference between the pre-pilot is usually a series of open-ended questions that are used to generate categories for closed, typically multiple choice questions. The pilot is used to test the actual survey instrument itself" (p.173). For this study the questionnaire was sent to various interested parties for their comments and suggestions. Burgess (2001) added an important point in his study of a guide to questionnaire design:

The questionnaire should begin with questions that will raise interest. However, there are different views on the sequencing of questions. For example, someone might argue that the easier questions to answer should be at the beginning to get the respondent into the swing of things. However, someone else might suggest that questions about personal data, that are easy to answer, should be left until the end when the respondent has committed themselves to answering and they are less likely to object. For example, group together all questions that relate to similar areas and keep the flow through a questionnaire logical and very simple. (p.7)

Every step needs to be designed carefully because the final results are only as good as the weakest link in the questionnaire process. Although questionnaires may be cheap to administer compared to other data collection methods, they are every bit as expensive in terms of design time and interpretation (David, 1997).

The main data collection method selected for this research was the questionnaire, as this form of data collection helped ensure that the data was valid and reliable. Upon completion this data was analyzed and compared. The questionnaire provided teachers with some open-ended opportunities, to expand and clarify their responses.

The posted questionnaire used in this research had four sections. Section one was made up of general questions about teachers themselves and their beliefs about ICT. Section two focused on teachers' current use of ICT tools. Section three focused on teachers' professional development. Section four related to improving ICT use in the

classrooms. In this survey, the researcher used the term “ICT” to refer to information communication technology tools in education such as computer lab networks, digital microscopes with sensors, projectors, electronic whiteboards, desktop/laptops, scanners, overhead projectors, digital cameras, Internet etc. This questionnaire was translated into the Arabic language and script. In this research, all the quantitative data was computed and analyzed using the statistical package for Social Scientists (SPSS). The open-ended questions and short answers were analyzed using grounded theory (Strauss & Corbin, 1998).

Questionnaire returns

Of the total sample of two hundred distributed questionnaires (one hundred to male teachers and one hundred to female teachers), the return of completed questionnaires was 131, around sixty five percent, the male teachers contributing 86 (43 %) and the females 45 (22 %). Actually, the overall net returns are to be considered a ‘very good response rate’ even there was a differential of twenty two percent between female and male. Anecdotal evidence suggests that the differential responses from the female teachers maybe largely attributable to cultural and religious factors. Therefore, future research should be modified to accommodate these factors and hopefully achieve a higher response rate from female participants.

Translator

When the ethics proposal for this research was considered by the Ethics Committee of the Centre for Science and Technology Education Research, the suggestion was made that translators might be needed to ensure that participants understood questions, and to also ensure that the participants’ views were clearly expressed. Therefore, the questionnaire was sent to a translator, and the questionnaire was translated from English to Arabic, and returned to the researcher for checking. The questionnaire was then sent it to the administrators who distributed it to participants. After completion, the questionnaires were collected, sorted, coded, secured in sealed envelopes and posted to the agent in Bahrain for collation. Only responses to questions requiring

short or extended written answers were translated from Arabic to English as all other questions required only multiple choice “tick the box” responses.

Data collection

The government of Saudi Arabia requires that all research work carried out in Saudi Arabia must have official approval. In this educational research, the approval was required from the Ministry of Education. For the girls’ schools, a letter to the Ministry of Education requesting permission to do the research was forwarded to the General Manager’s Office in January, 2008. In the second week of January of that year, a letter, granting approval of the request, was received from the General Manager of Education. Permission was also obtained from the Director of the educational research department for The Secretary of Inspectors Department in Al-Khobar City of Girls’ Ministry to administer and undertake educational research in their schools.

Meetings between the administrator, principals of the schools and with the participants involved in this research were arranged accordingly. In the meetings with the school principals and with the science teachers, the details of the research were discussed and the process of filling out the questionnaire was explained by the administrator of girls’ schools.

After distribution of questionnaires, collection of data started. This took place in January and February of 2008. With the help of participants in the schools involved in this research, the administrator was able to administer the research questionnaire to all of the participants involved in three weeks. All the participants involved were required to complete all questions of the questionnaire prepared for the research. After completion, the questionnaires were collected and coded, secured in sealed envelopes and posted to the researcher by the administrator.

For the boys’ schools, a letter to the Ministry of Education requesting permission to do the research was forwarded to the General Manager’s Office in January, 2008. In

the second week of January of that year, a letter, granting approval of the request, was received from the General Manager of Education. Permission was also obtained from the Director of Educational Research Department for The Assistant Director of the Education Technologies Management in Al-Dammam City of Boys' Ministry to administer and to do the educational research in their schools. The administrator received that letter of permission from educational research department then he rang the researcher and asked him to send the questionnaires.

The administrator had received the questionnaires from the researcher and he looked at it, understood it and read the help sheet which was included with the guidelines for administering the questionnaire. The schools involved in this research had been chosen and also the cities that the questionnaires were distributed to were noted in the material as well. The questionnaires went to schools in Dammam city, Alkhobar city, Alqateaf city and Sufwa city. Meetings with the administrator and the Inspectors of Education Technologies Management who contributed and helped to distribute questionnaires to the schools were held. The administrator explained the guidelines for administering the questionnaire and the questionnaire itself as well for each representative and the way he could distribute the questionnaires to the teachers in selected schools was also explained. Then, the Representative of Education Technologies Management visited the schools that had been selected to contribute in this research and meetings with principals of the schools and with the participants involved in this research were arranged. In the meetings with the school principals and with the science teachers who voluntary participated in this research, the details of the research were discussed and the processes to complete the questionnaire were explained and Coordinator to follow up questionnaires in school was identified by the Representatives of Education Technologies Management.

After distribution of questionnaires in the schools in Saudi, collection of data was started on the next day by the Inspectors of Education Technologies Management. This took place in January and February of 2008. All the participants involved were encouraged to complete all questions of the questionnaire prepared for the research.

After completion, the questionnaires were collected and coded, secured in sealed envelopes and posted to researcher by the administrators of this research.

3.5 Ethical Considerations and Access

This study involved a cohort of 131 Saudi secondary schools science teachers from both girls' and boys' schools. The participants are representative of three different groups of schools: Aramco company's schools, public schools, and small schools in rented premises. For the girls' schools, access to teachers was by first gaining approval from the General Manager of the Ministry of Education to administer the questionnaire (see Appendix 1 attached).

Participants received an invitation letter to participate in the study, including information about their participation being voluntary and all responses being confidential and anonymous. Signatories to the letter were from both the Secretary of Inspectors Department in Al-Khobar City, Mrs. Khoud Abdullah Almaghlouth for the girls' schools, and from the Assistant Director of the Education Technologies Management in Al-Dammam City, Mr. Moammar bin Gersan Alzahrani for the boys' schools (see Appendix 3 attached). They were asked to give their informed consent to participate (see Appendix 4 attached) before data collection. For the boys' schools, access to teachers was by first getting approval from the General Manager of Ministry of Education to administer the questionnaire (see Appendix 2 attached). Participants received a letter inviting them to participate in the study, including information about their participation being voluntary and all responses being confidential and anonymous (see Appendix 3 attached), to participate in the study. They were asked to give their informed consent to participate (see Appendix 4 attached) before data collection. This was done after both the targeted teachers and principals had given their permission.

Anonymity of participants

Teachers' anonymity was preserved by the use of labels (A, B, C...) instead of names in the responses. In the final report, neither labels nor names have been used and the names of the schools and teachers have been changed to protect their confidentiality.

Confidentiality

Confidentiality was respected and maintained at all times, participants were asked not to add their signature or any other identifying label to the questionnaire. The completed questionnaires were not accessed by anyone other than the researcher, the supervisors and the administrators who had been given permission by the researcher. The two administrators collected, coded, and secured the questionnaires in sealed envelopes and posted them to the researcher. Furthermore, they were asked to sign an agreement form to not read the questionnaires for any reason (see Appendix 6 attached). The data will not be used for anything other than this study and publication of results. Since the questionnaires did not bear the participants' names, the analysis and report writing used codes/numbers and no real names have been used. Every effort was made to uphold the participants' anonymity and to avoid any adverse impact on them. Data is to be stored securely and destroyed three years after the completion date of the study.

Ethical statement

The research followed the University of Waikato Human Research Ethics Regulations 2000 and the ethical guidelines of the NZARE. Informed consent of participants was sought and given, without coercion. Elements of exploitation (or the perception of exploitation) within the researcher-participant relationship were closely addressed and avoided. Privacy and confidentiality were respected. The participants were granted ownership of the raw material collected, and any requests regarding their data were honoured. Participation in the research in no way impacted on the careers of the participants and the names of the schools and teachers were encoded to protect their confidentiality.

3.6 Research Design and the Role of the Research

Role of the researcher

When expressed in the language of society rather than that of academia, the complexity and variety of roles that the educational researcher must assume takes on staggering proportions. The researcher must function, at times separately and at other times jointly as administrator, educator, facilitator, technician, arbiter, moderator, protector, detective, strategist, politician, diplomat and last but not least, a professional academic researcher (Hamdan, 2005).

Harlen, (1993) in defining the role of educational researchers in developing public understanding of education, gives a generalized description of that role:

To seek, to advance understanding of the world around us depends on human judgment is a social enterprise; that builds upon previous knowledge and understanding; that uses a wide range of methods which are tentative and always open to challenge by further evidence; that is constrained by values and is subject to social determination of the acceptability of its conclusions.
(p.3)

Harlen adds that the researcher needs to do more to reach the policy-makers, although they will be aware of what is published in the press. Somehow he must create opportunities where he can discuss, in a non-confrontational manner, what research is saying that is relevant to their policy decisions. There is, no doubt, a considerable gulf between the researcher and the policy-maker. This observation again addresses the role of politician within the researcher but further extends that role to embrace diplomatic skills in bridging the gulf between the parties.

The researcher needs to write and publish from a research standpoint in order to explain that his studies have put him in a position to comment on the validity of arguments put forward and claims made. Furthermore, he needs to point out in straightforward terms where there is evidence to support the claims and where there is

not, and where there is research evidence from which likely consequences of certain actions might be predicted and should be considered. Harlen (1993) provides a clear emphasis on issues of evidence, claims, actions and predictions. These aspects of the educational researcher's function relate well to those of the detective or policeman, albeit a more altruistic version than these roles in reality. In further support of the protector/policing role, American Educational Research Association (1992) noted that:

Researchers, research institutions, and sponsors of research jointly share responsibility for the ethical integrity of research, and should ensure that this integrity is not violated. While it is recognized that these parties may sometimes have conflicting legitimate aims, all those with responsibility for research should protect against compromising the standards of research. (p.9)

This research was my first journey into qualitative and quantitative research. As explained in Chapter 1, my educational background was in Management Information System (MIS); I have a Bachelor degree of MIS, King Faisal University in Al-Hasa, 1994 and Postgraduate Diploma of Education (Technology Education), The University of Waikato, 2007. I came to this research with an interest in the issue of the use of ICT, in particular, in science teachers' current use of specialist science ICT tools. I have had formal training and experience in school teaching for five years and I taught computer science in secondary schools. Then I moved to work with the Ministry of Education for another five years and was a supervisor in the education technologies department between 2000 and 2005. I visited schools as an advisor on ICT tools and over the five years was involved with the education technologies management in Dammam City as a technology trainer. One of the responsibilities of that management role was providing information communication technology (ICT) tools to the schools, across primary, intermediate and secondary levels in the Eastern district. These ICT tools were designed to be used in all curricula areas as teaching aides and also to educate both teachers and students on their value in supporting teaching and learning.

My experience, I believe, has equipped me with the knowledge of the processes and peculiarities of Saudi secondary school education. The spur to undertake this research was a direct response to my growing awareness of the aversion, obvious in many of my colleagues, to the active use of ICT tools at their disposal.

The methods used in this research presented several challenges, in particular, the great deal of time that was spent before the research began in formulating a relatively robust research design and the formulation of questionnaire guides and questions. I attempted to encourage all participants involved in this research to complete all the questionnaire questions by providing incentive gratuities in each envelope such as, pencils and small key medals and on the cover of the key medals a lot of gratitude has been written included, the name of the research and the name of researcher. As Cohen et al. (2005) noted, to maximize response rate, the researcher should use incentives. They added that there are other factors that might increase response rates, such as, the use of good-quality envelopes and a typed address to a named person wherever possible.

Place in which the research was conducted

This study involved 131 Saudi science teachers from both girls' and boys' high schools. The participants were from different categories of school: Aramco company's schools, public schools, and small schools in rented premises.

Selection of the sample

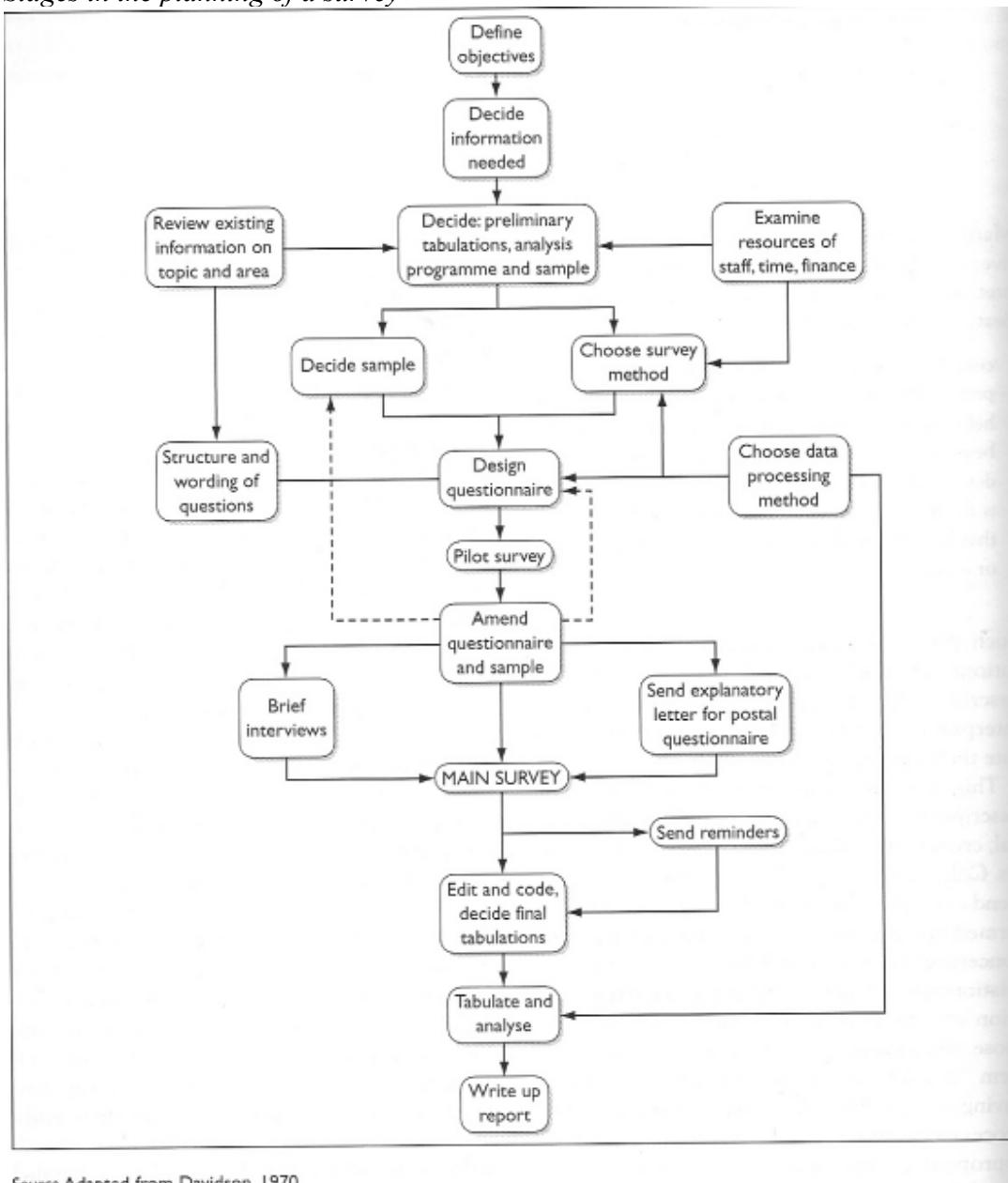
By definition, the sample is the actual group to be contacted in some way and accordingly, there are several important sampling issues to be considered. As defined graphically by Davidson (1970) (see Figure 3.1 below) there are a number of specific determinations to be addressed in formulating the parameters of a sample and notably, these are inter-dependent.

In addition, this questionnaire was conducted using the fourth method of Davidson (1970) as mentioned in Table 3.1 which was a postal survey method. Trusted administrators were chosen for both liaison with female and male teachers.

Table 3.1
Questionnaire methods (Davidson, 1970)

METHOD	CONTENT	SAMPLE	RESPONSE	COST
Home interviews	Full range of information possible, including profile questions (5.5); can last an hour or more.	Random sample fairly easily obtained; sample frames exist for selecting contacts (3.20).	Normally over 85% but varies; information improved by interviewer 'rapport', but possibility of interviewer bias. Full potential of method only realised with trained interviewers.	Expensive: often £2+ per interview using professional staff (excl. travel and materials) i.e. cost for 1000 interviews = £2000.
A	Fewer profile questions than A and wise to limit number of attitude questions (5.12). Best to keep interview to 10 minutes or less.	Quasi-random selection normally possible, but need careful choice of survey area and time. Difficult to cover a large geographical area.	Normally over 80% with advantages as A, but probability of greater interviewer bias, especially where no sample frames exist for easy selection of respondents.	Fairly expensive: for 1000 interviews cost is £100+ with students @ £4/day (assuming 6 interviews/hour, for a 6 hour day).
B	Less detailed and fewer profile and attitude questions than B. Self-completed questionnaires	As B, but time saved in distribution rather than interviews can be used to survey a wider area or more occasions.	Over 60% possibly 80% where forms are to be collected or where a reminder can be sent for a postal return. Problems of poor information as in D, but no interviewer bias.	Cheap: cost of pay, travel and subsistence of distributors, but fewer needed for same sample cf. A or B. Cheapest where staff already employed in an area on other jobs.
C	Simple questions with as few as possible on profile information or attitudes. Form should be short; extra care needed on design.	Can aim for random sample questionnaire is passed on. Easy to cover large area.	Often below 60% but with good questionnaire and reminders, can be 80%. Problems of bias by non-response, lies, facetious replies, but no interviewer bias.	Fairly cheap: cost of materials and staff to dispatch; 1000 completed forms for £50 (with 1 reminder and assuming a good response).
D	Postal surveys			

Figure 3.1
Stages in the planning of a survey



Source Adapted from Davidson, 1970

Central to the sample design is the definition of the respondent(s); determinations of size of the sample within the constraints of time, money and human resources; appropriate decisions concerning choice of random or selected sample and, of course, survey method (Cohen et al. 2005; Molhem, 2005; Trochim & Donnelly, 2006). The sample of this research was comprised of one hundred female teachers from girls'

schools and one hundred male teachers from boys' schools. All of the samples were science teachers whose classrooms were provided with different ICT tools such as digital microscopes with sensors, data show/projectors, electronic white boards, digital cameras, audio-visual devices and supporting software.

Profile of the sample

Private schools were not part of this study. The two hundred participants in this research were:

Girls' Schools

Aramco company's schools: (1 school)

Public schools: (9 schools)

Small schools in rented premises: (2 schools)

45 Female Participants

3 teachers from each school

3 to 6 teachers from each school

2 teachers from each school

Boys' schools

Aramco company's schools: (3 schools)

Public schools: (19 schools)

Small schools in rented premises: (2 schools)

86 Male participants

3 to 6 teachers from each school

3 to 6 teachers from each school

2 to 3 teachers from each school

The sample, based on science subjects was selected as follows:

Chemistry subject (3 to 6 teachers from each school).

Biology subject (3 to 6 teachers from each school).

Physics subject (3 to 6 teachers from each school).

The aim of this sampling was to target enough teachers to provide characteristic responses concerning attitudes, opinions and perceptions of the larger teacher population regarding the use of ICT tools in support of teaching and learning.

Actually, the response rate was high as the number of responses was hundred thirty one out of two hundred, nearly 65 % percent. And the cost of postal survey was cheap for the researcher.

Profile of participants

The questionnaire was posted to Saudi Arabian science teachers from both girls' and boys' high schools in different socio-geographic locations. The male participants were selected from the districts of Dammam, Alkhobar, Aldahran, Alqateaf and Sufwa. The female participants were selected from just two districts, Alkhobar and Aldahran, because it was difficult for the administrator who was responsible for distribution of the questionnaires in female high schools to move from one city to another and these two cities were close to her work location.

3.7 Data Analysis

This section reviews the data analysis of the questionnaire and in particular, the method of analysis. Gorard (2001) emphasised the need to consider data analysis methodology options as preliminary to all other design concerns. He stressed that it is not possible to design a sensible research instrument without considering in some detail how the data collected will be analysed. In failing to address this imperative, there is no check that the right questions have been asked, or data collected in the right format. Gorard added that the apparently separate phases of reading, formulating research questions, design, and collection of data, analysis, and reporting are really concurrent and interactive functions. He added that:

...questionnaire design is the key to survey analysis. You do not commit yourself to any particular form of analysis just by thinking about it before designing your questions. But you do restrict the kinds of analyses available to you by the design of your instrument. Therefore consideration of analysis is more like the first rather than the last stage of research design. (p.9)

Delamont (1992) summarized several basic rules of analysing data. The data should be analysed directly after collection by coding/indexing the data, as it will be easy to identify what had been collected. Categorize the data. Sort the data into files and review them from time to time. Write analytic memos as often as it can to enable reviews. Research the work of peers to provide background on ideas, models, parallels, contrasts, descriptions, etc. all those rules will help to analysis the data.

Two indexing tables were developed by the researcher for the data, for girls' schools and boys' schools. The data were indexed within the three categories of schools as shown below.

Girls' schools

Aramco company's schools: ARMC(F)	3 to 6 teachers from each school
Public schools: GOVR(F)	3 to 6 teachers from each school
Small schools in rented premises: GOVR/R(F)	3 to 6 teachers from each school

Boys' schools

Aramco company's schools: ARMC(M)	3 to 6 teachers from each school
Public schools: GOVR(M)	3 to 6 teachers from each school
Small schools in rented premises: GOVR/R(M)	3 to 6 teachers from each school

The teachers were given a code according the school name, city and questionnaire number.

Validity and reliability

While there are many different points of view regarding academic definitions of validity and reliability, this research used 'validity' as defined by Cohen et al. (2005): "validity is an important key to effective research" (p.105). This research was conducted using a questionnaire with a sample of two hundred provincial Saudi secondary school science teachers from both girls' and boys' high schools. That sample size was determined to ensure valid results as it represented Sixty five percent of the combined total of teachers within the selected category. To achieve quality in the form of questions, the researcher must address not only substance, but style. Molhem (2005) explained that in order to obtain valid information from the chosen method, the questionnaire should ask purposeful questions, concrete questions, allocate time periods based on the importance of the question and use conventional language. The questions should be easy and understandable. Questions may be designed to gather either qualitative or quantitative data. By their very nature,

quantitative questions are more precise than qualitative. Also the question should focus on one point of enquiry. In this research, questions relating to specific areas of enquiry were asked in different ways in order to triangulate the responses and thereby ensure quality analysis. Furthermore, the questionnaire was designed to help respondents to explain observed patterns or differences in personal behaviour and that of other people (Worthen, Borg, & White, 1993).

Interestingly, Cohen et al. (2005) have defined reliability as “essentially a synonym for consistency and replicability over time, over instruments and over groups of respondents” (p.117). To increase/maximize the response rate and the reliability of the questionnaire, Cohen et al., noted that the researcher should provide stamped addressed envelopes, clearly explaining the importance of the questionnaire. In addition, they added that the advantage of the questionnaire tends to be more reliable because it is anonymous. It encourages the participants to answer the question with confidence and honesty.

However, the main issue with the validity and reliability of questionnaire survey is the size of sample. If the sample is too small or too large, it can simply undermine the quality and validity of the data. The Reliability analysis of this research was done by using Alpha Cronbach’s Value which is in the SPSS programme. It is clear evidence from the following table that there is a reasonable reliability according to Alpha Cronbach’s Value.

Table 3.2
Cronbach values of questionnaire sections

Section	Alpha Cronbach's Value
Section 2	.764
Section 3	.877
Section 4	.765
Total	.798

3.8 Summary

This chapter was introduced the methodology of this research in four sections. Section 3.1 introduced the research focus which illustrated the research questions, and section 3.3 described the research methods: interpretive research which was based on the theoretical premise that the researchers who wish to understand a situation should seek to understand the perspectives of the people involved in that situation. Consequently, interpretive research relies heavily on the use of questionnaires as a means of collecting data that was presented in Section 3.4. In this research, the questionnaire was used as the data collection method. Section 3.6 explained that the research was designed to investigate the Saudi secondary school science teachers' beliefs about the benefits and impacts of ICT use in the classrooms in their use of ICT. That section gave details about how the questionnaire was conducted, how the data were handled, and how issues relating to research ethics, reliability and validity were dealt with. The bulk of the data collection for this research was directed towards answering research questions. Chapter 4 presents the results of this research. A discussion of those research questions will be presented in Chapter 5.

CHAPTER 4

RESEARCH RESULTS

4.0 Introduction

This chapter describes the results of the data collection and analysis for the Saudi science secondary school teachers' responses to their current use of ICT, professional development and their beliefs about ICT.

Table 4.1
Sample profile (Values shown as frequency)

Number of schools			City name
Public	Rented	Aramco	
9	2	1	Alkhobar, Aldahran
19	2	3	Aldammam, Aldahran, Alqateaf, Sufwa
28	4	5	Total: 37 schools

The questionnaire (see Appendix 1) was distributed to two hundred female and male science teachers in three different types of schools. There were 28 government schools (9 girls' and 19 boys' schools), four small schools in rented premises (2 girls' and 2 boys' schools) and four Aramco schools (1 girls' and 3 boys' schools) (see Table 4.1). These schools were also in different districts: Aldammam city, Alkhobar city, Aldahran city, Alqateaf city and Sufwa city. The teachers were asked to voluntarily participate in the study and 131 teachers out of 200 (86 male and 45 female; 65%) completed the questionnaire.

This chapter presents the findings in regard to the research questions:

- 1) In what ways do Saudi secondary teachers use ICT?
- 2) In terms of ICT skills and knowledge, what do Saudi secondary school teachers think are their needs for improving the use of ICT use in the classroom?
- 3) What are Saudi secondary school teachers' current perceptions of ICT?

The results presented in this chapter are in the form of percentages, for both current use of, and beliefs about, ICT tools. The results in the professional development section were obtained from teachers' responses to short answer questions.

The participants in this research were male (43 %) and female (22 %) science teachers and who taught three different subjects, physics (28 %), chemistry (35 %), and biology (37 %). They taught at different grade levels in their schools. There were 41 percent who taught grade level 3, 35 percent who taught grade level 2, and 24 percent who taught grade level 1. Teachers who participated in this research were from four different ranges of years of teaching experience. Around 38 percent had taught their subject for one to five years. Nearly the same percentage 39 percent had taught for five to ten years. Some teachers had taught from ten to fifteen years (17 %) and only 5 percent of research participants in this study had been teaching for fifteen years or more. Just over half (52 %) of these teachers were aged between 31 and 40 years, while only 8 percent were aged between 41 and 50 years. Only one teacher (GOVR M-120) was aged between 51 to 60 years.

4.1 Teachers' Current Use of ICT Tools

This section provides the answer to the question: In what ways did Saudi secondary teachers use ICT? This section will examine the following topics, rating of teachers' ability to use ICT tools, ICT tools available at schools, ICT tools most used in schools, application of ICT use, reasons for using ICT tools, and implementation of ICT activities.

In general, both female and male teachers responded that their ability to use ICT tools fluctuated between beginner (41 %) and intermediate (52 %) (see Table 4.2). Only 7 percent of these teachers considered themselves an expert in the use of ICT tools. Most of them (52 %) had between one and five years ICT experience. Significantly, 9 percent of female teachers considered themselves to be expert users of ICT whereas only 5 percent of male teachers considered themselves expert in this field.

Table 4.2
Participants rating of their ability to use ICT tools.

			GENDER		Total
			MALE	FEMALE	
How would you rate your ability to use ICT tools?	Beginner	Count	32	18	50
		% within GENDER	40.5%	41.9%	41.0%
		Count	43	21	64
	Intermediate	% within GENDER	54.4%	48.8%	52.5%
		Count	4	4	8
	Expert	% within GENDER	5.1%	9.3%	6.6%
		Count	79	43	122
	Total	% within GENDER	100.0%	100.0%	100.0%

As Table 4.3 shows, nearly all these teachers (92 %) had a personal computer. Around half of them (52 %) had owned their computers for 6 to 10 years, while others (34 %) had owned their computers for 3 to 5 years and only 15 percent had had their computers for 1 to 2 years (see Table 4.3).

Table 4.3
Number of teachers who have had personal computers

			GENDER		Total
			MALE	FEMALE	
Do you have a personal computer?	Yes	Count	79	38	117
		% within GENDER	96.3%	84.4%	92.1%
	No	Count	3	7	10
		% within GENDER	3.7%	15.6%	7.9%
	Total	Count	82	45	127
		% within GENDER	100.0%	100.0%	100.0%

Table 4.4
Period of years that teachers owned their personal computer

			GENDER		Total
			MALE	FEMALE	
For how long do you have one?	1-2 years	Count	10	7	17
		% within GENDER	12.8%	18.4%	14.7%
		Count	23	16	39
	3-5 years	% within GENDER	29.5%	42.1%	33.6%
		Count	45	15	60
	6-10 years	% within GENDER	57.7%	39.5%	51.7%
		Count	78	38	116
	Total	% within GENDER	100.0%	100.0%	100.0%

Participants were also asked (question 8, see Appendix 1) what ICT tools were available for them to use in their school. Table 4.5 (below) reports the percentage of common ICT tools that were available for these 131 science teachers in 2008.

This study found considerable variation in the availability of ICT tools. Tools such as ‘digital projector’, ‘printers’, ‘TV monitor/VCR/DVD player’ and ‘overhead projector’ seemed to be the most common tools available for science teachers in their schools. Statistically, a ‘digital projector’ was the most commonly available tool (83 %). Next, were a ‘printer’ (76 %) and ‘TV monitor/VCR/DVD Player’ (67 %). At the same time, tools such as ‘digital microscope (36 %)’, ‘scanner’ (31 %) and ‘digital camera’ (26 %) were less available in these schools. For clarity, Table 4.5 and Figure 4.1 show marked differences between the availability in individual schools.

Table 4.5
ICT tools available in schools (Values shown as %)

Tools	Available	
	Yes	No
Digital Projector	83	17
Printers	76	24
TV monitor/VCR/DVD player	67	33
Overhead Projector	54	46
Digital Microscope	36	64
Scanner	31	69
Digital Camera	26	74
Interactive Whiteboard	22	78
Laptop for Teacher Use	19	81
Student Computers in a Lab	16	84
Classroom Computer for Teacher Use	12	88
Portable Computer Units	8	92
Student Computers in Classroom	3	97

Tools such as ‘student computers in classroom’ (3 %), ‘portable computer units (8 %), ‘classroom computer for teacher use’, (12 %) and ‘student computers in a lab’ (16 %) showed the lowest percentage of available tools at schools. This may be because commonly, the secondary schools in Saudi Arabia have computer labs for the use of computer science teachers and other teachers as well.

Small schools in rented premises had some ICT equipment installed. Table 4.6 (below) showed that four small schools in rented premises (2 girls' and 2 boys') were limited to 'digital projector', 'printers', 'TV monitor/VCR/DVD player' and 'digital camera' and only one rented school in the districts that were selected for the study had a 'digital microscope' and 'portable computer units'. On the another hand, four Aramco schools (1 girls' and 3 boys') were also equipped with some tools such as 'digital microscope', 'digital projector', 'TV monitor/VCR/DVD player', 'printers', 'scanner', 'overhead projector'. There were only two schools which had both 'portable computer units' and 'classroom computers for teacher use'.

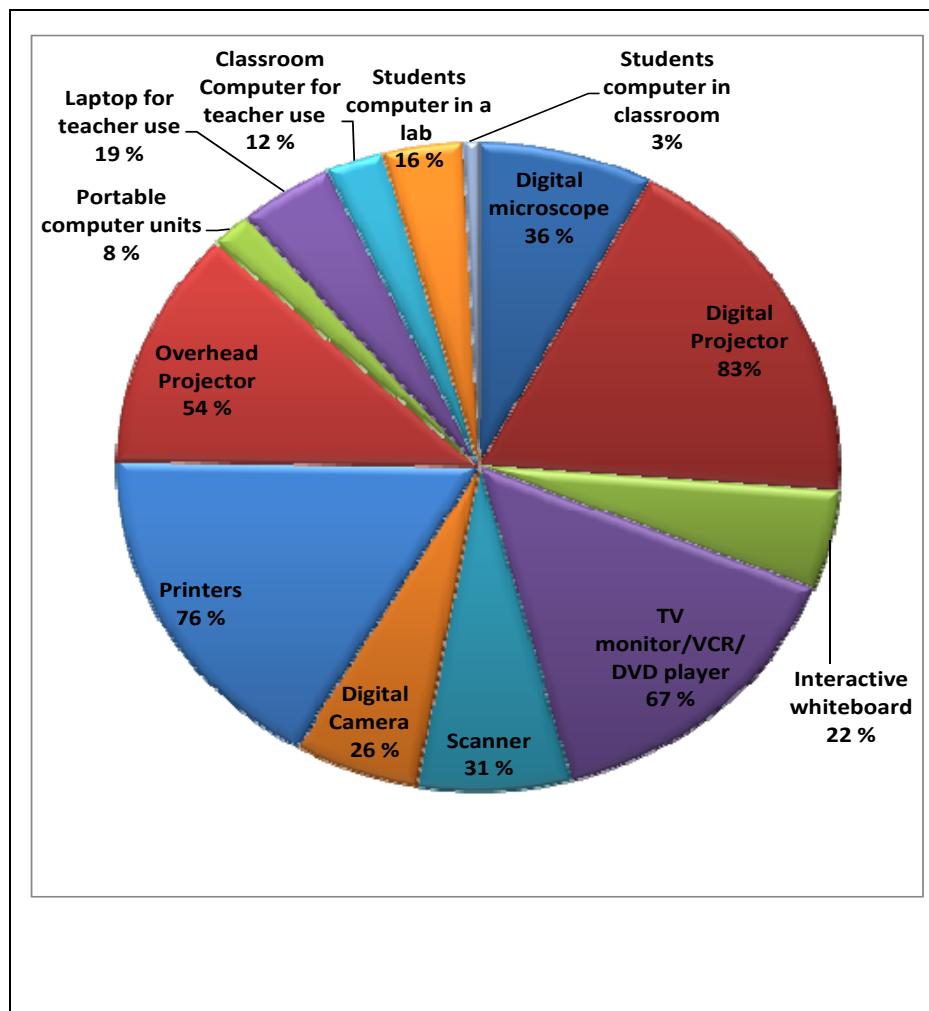
Table 4.6
ICT tools available in schools in rented schools and Aramco schools

Tools	Available							
	Rented schools				Aramco school			
	Girls		Boys		Girls		Boys	
	School 1	School 2	School 1	School 2	School 1	School 1	School 2	School 3
Digital Microscope			yes		yes			
Digital Projector	yes	yes		yes	yes	yes		yes
Interactive Whiteboard								yes
TV Monitor/VCR/DVD Player	yes	yes	yes	yes	yes	yes	yes	yes
Scanner								yes
Digital Camera			yes			yes		yes
Printers	yes	yes	yes	yes	yes	yes	yes	
Overhead Projector					yes	yes	yes	yes
Portable Computer Units			yes					yes
Laptop for Teacher Use								
Classroom Computer for Teacher Use						yes		
Student Computers in a Lab								
Student Computers in Classroom								

The results shown in Table 4.5 indicated that the Ministry of Education had devoted their efforts to providing schools with different types of ICT tools such as 'digital projector', 'printer', 'TV/monitor/VCR/DVD player' and 'overhead projector', which helps all the teachers in the schools whatever their subjects. Science teachers were also provided with specialist tools, particularly tools such as 'digital microscope' and

'interactive whiteboard'. Teachers with these tools were able to modify their teaching methods, giving them opportunities to present their lessons more effectively.

Figure 4.1
ICT tools that were available in schools (Values shown as %)



Participants (question 10, see Appendix 1) were asked to indicate which specific ICT tools they used from the tools that were available to them at their schools. For clarity Table 4.7 and Figure 4.2 both illustrate the percentage of ICT tools that were used by science teachers in their schools. The science teachers in this study used a 'digital projector' (69 %), 'printer' (59 %), 'TV monitor/VCR/DVD player' (51 %), 'overhead projector' (41 %) and 'laptop for teacher use' (33 %). Other tools, like

‘interactive whiteboard’ teachers used less (12 %), ‘digital camera’ (14 %), ‘classroom computer for teacher use’ (11 %), ‘digital microscope’ (16 %), ‘students computer in a lap’ (15 %) and ‘scanner’ (15 %). There were marked differences in the lowest percentages in the use of these tools. For example, for ‘student computers in classroom’, the use was only (4 %).

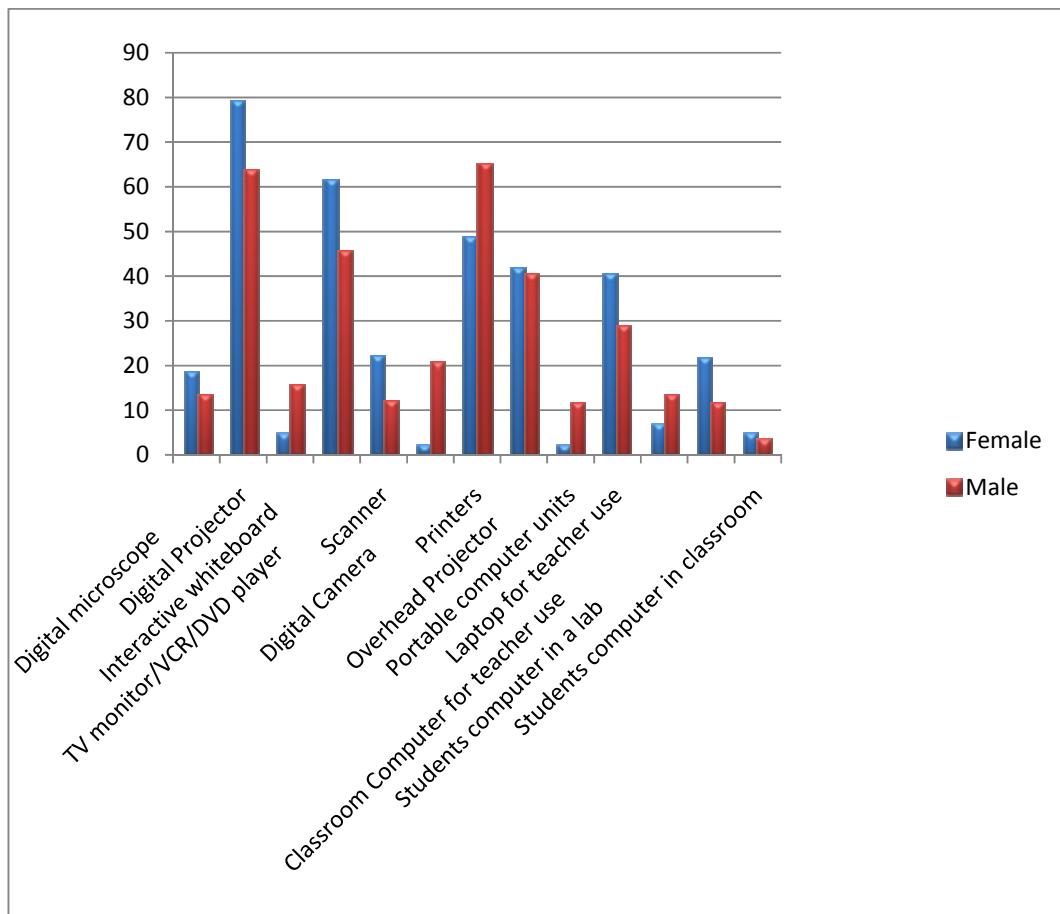
Thus, ‘digital projector’ was clearly the most frequently used tool for all almost all of these science teachers, with ‘student computers in classroom’ being the least used.

Table 4.7
ICT tools most used by teachers (Values shown as %)

Tools	Female teachers at girls' schools	Male teachers at boys' schools
Digital Projector	79	64
TV Monitor/VCR/DVD Player	61	46
Printers	49	65
Overhead Projector	42	41
Laptop for Teacher Use	40	29
Scanner	22	12
Student Computers in a Lab	21	12
Digital Microscope	19	14
Classroom Computer for Teacher Use	7	14
Interactive Whiteboard	5	16
Student Computers in Classroom	5	4
Digital Camera	2	20
Portable Computer Units	2	12

Figure 4.2

ICT tools most used in schools (Values shown as %)



Teachers were asked to indicate the percentages of their use of each of the 13 types of the ICT tools listed (in question 10, see Appendix 1). Their responses were scored as follows: daily, 3 times a week, once per week and less than once a week for each of 13 types of ICT tools. Four items were used at least once per week by approximately 50 % or more of respondents. These were a ‘digital projector’ (71 %), ‘TV monitor/VCR/DVD player’ (58 %), ‘printers’ (59 %) and ‘laptop for teacher use’ (48 %). The ‘digital projector’ was the most common tool that teachers used, at least 3 times a week (20 %), about one third of teachers (35 %) used it once per week; while 29 percent used it less than once a week. Other tools that teachers used at least 3 times a week were ‘TV monitor/VCR/DVD player’ (34 %) followed by ‘printers’ (25 %) and ‘overhead projector’ (18 %).

The lowest percentage of use of any ICT tool by teachers was for both the ‘classroom computer for teacher use’ and ‘student computers in classroom’, which were used 3 times a week by only 2 % of the respondents.

Table 4.8
How often teachers use ICT tools (Values shown as %)

Tools	Daily	3 times a week	Once per week	Less than once a week
Digital Microscope	16	5	9	70
Digital Projector	16	20	35	29
Interactive Whiteboard	18	7	5	69
TV Monitor/VCR/DVD Player	11	13	34	42
Scanner	17	7	5	70
Digital Camera	14	7	7	72
Printers	16	18	25	41
Overhead Projector	11	11	18	60
Portable Computer Units	17	3	3	76
Laptop for Teacher Use	24	8	15	52
Classroom Computer for Teacher Use	20	2	9	69
Student Computers in a Lab	17	6	6	70
Student Computers in Classroom	19	2	2	76

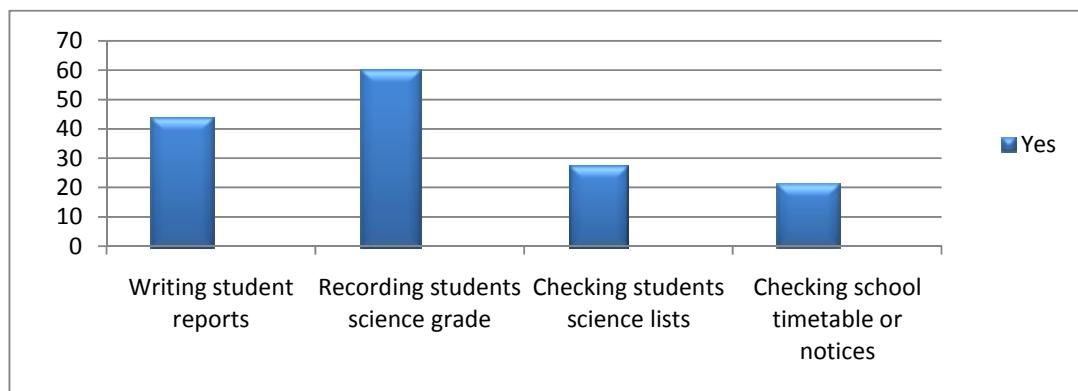
Teachers in this study were asked to specify what they use ICT tools for: Administration; communication; lesson planning and or preparation in the classroom; or for evaluation and assessment (see question 11, Appendix 1). These five categories were split further into the types of expected activity that may be undertaken under these categories (see Table 4.9).

Table 4.9
Applications of ICT Use (Values shown as %)

Administration	Communication	Lesson planning and preparation	In the classroom	Evaluation and assessment
writing student reports	contacting colleagues via emails	reviewing resources	using curriculum-specific software	motivating students
44	29	44	36	48
recording student science grade	participating in online discussion lists	accessing the Internet	Presentations	creating interactive science test/quiz
60	16	56	53	53
checking students science lists	collaborative development of units	producing lesson materials	teacher access to Internet during lessons	give/get immediate feedback to/from students of exam
27	9	63	2	32
checking school timetable or notices	accessing the Internet for professional reading, subject association news, etc.	preparing students handouts and worksheets	teacher access to projector	analyses data statistically
21	63	71	56	7

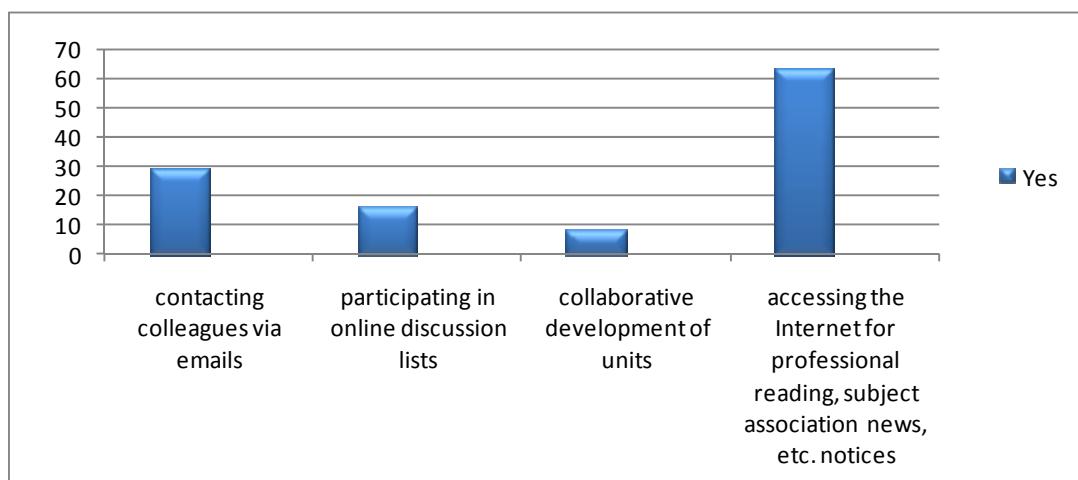
Regarding ICT tools use for administration, 60 percent of these teachers used ICT for recording student grades, 44 percent used ICT for writing students' reports and 21 percent for checking school timetables or notices.

Figure 4.3
Teacher Use of ICT for Administration (Values shown as %)



In the second category, communication, the high use of ICT was clearly indicated in accessing the Internet for professional reading, and associated subject news. Teachers were primarily interested in accessing information and knowledge through the Internet (63 %) (see Figure 4.4). Science teachers in this study were also contacting colleagues via email to increase their knowledge (29 %), as well as participating in online discussions (16 %). Only 9 percent of participants indicated they were using ICT for the collaborative development of units.

Figure 4.4
Teacher Use of ICT for Communication (Values shown as %)

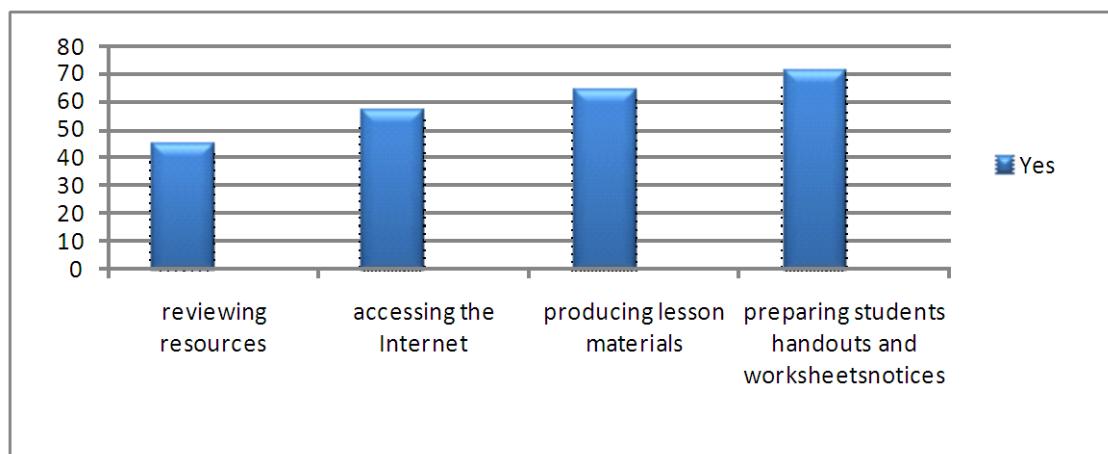


This research found that a high percentage of teachers use ICT for lesson planning and preparation. Most of the teachers used ICT for student handouts and worksheets (71 %), for producing lesson materials (63 %), for accessing the Internet (56 %) and for reviewing resources (44 %). One of the teachers explained:

I use ICT tools to perform interactive educational projects for Physics and also, I use ICT tools to research my subject. (GOVER F-24)

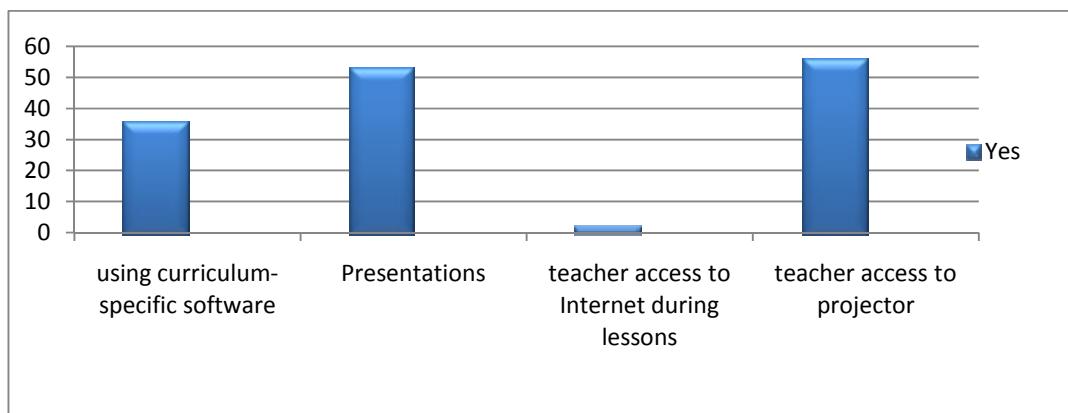
Figure 4.5

Teacher Use of ICT for Lesson Planning and Preparation (Values shown as %)



Analysis of the questionnaire results demonstrated the use of ICT tools in the classroom. The highest percentage in this category was for access to the projector, as it was the most commonly tool used amongst 37 secondary schools (56 %); the second most common usage was for presentation (53 %), followed by curriculum-specific software (36 %) and only 2 percent of teachers accessed Internet during lessons.

Figure 4.6
Teachers' Use of ICT in the Classroom (Values shown as %)



These teachers perceived ICT tools had opened opportunities for them for the evaluation and assessment as well as contributing to student motivation. Most of the science teachers who were involved in this study were trying to evaluate and asses their students using ICT tools (53 %) and had made progress in creating interactive science test/quiz.

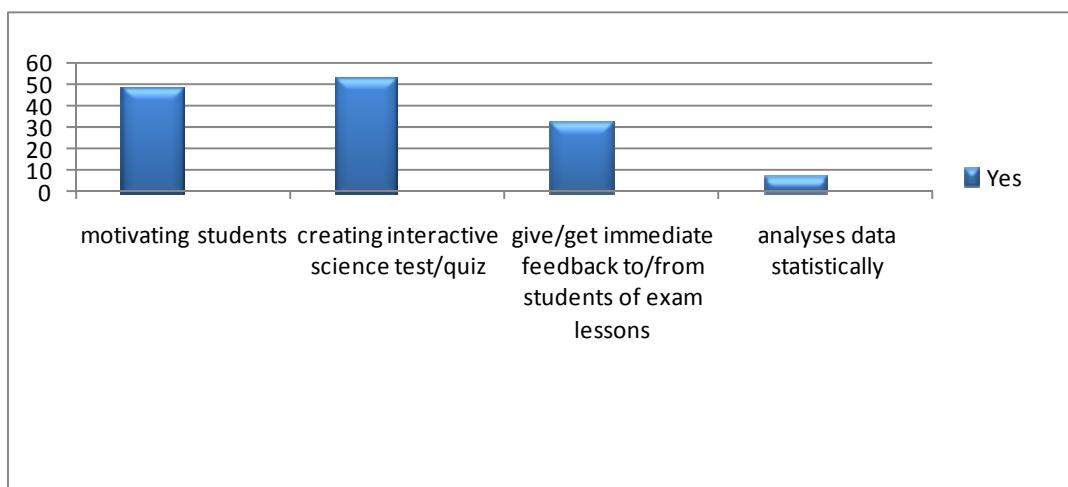
One female teacher commented that:

Students' motivation increases when they use ICT tools. (GOVR/R F-17)

Around 48 percent of teachers used ICT with their students to motivate them. And 32 percent of teachers said they gave/received immediate feedback to/from students of exam lessons, using ICT for that purpose.

Figure 4.7

Teacher Use of ICT for Evaluation and Assessment (Values shown as %)



They were also asked (question 12, see Appendix 1) to voluntarily write down the reasons that they used ICT tools. As shown in Table 4.10, a total of 13 different reasons were given by science teachers. Around two thirds of male teachers (66 %) and female teachers (67 %) stated the reasons that they use ICT tools because of time efficiency, personal enjoyment and motivation, student interaction and ease of lesson delivery. In addition, teachers (55 % male; 49 % female) gave their reasons for using printers as providing their students with handouts, worksheets and other subject materials. Teachers' laptops were principally used for lesson preparation, access to the Internet and the presentation of structured laboratory experiments, (male 38 %; female 62 %). Even though tools such as 'digital microscope', 'interactive whiteboard', 'digital camera' and 'portable computer units', had been provided for science teachers, few teachers were able to use them, perhaps for technical reasons and/or because they needed further skills and knowledge in order to use them effectively. One male teacher noted that:

We cannot use the 'interactive whiteboard'. Even though, it is at the school, it has never been installed and no training has been provided. (GOVR M-115)

Although a low percentage of teachers who had used these tools (see Table 4.10) found benefits if they integrated the use of these tools into their subjects, as they stated in their reasons. For example, teachers (16 % male; 22 % female) used the ‘digital microscope’, because they wanted to demonstrate to their students an accurate microscope and their students enjoyed using the digital microscope.

Table 4.10

Reasons: for Teachers who used Specific ICT Tools (Values shown as %)

Tools	Male		Female		Reasons (for teachers who used specific ICT tools)
	No	Yes	No	Yes	
Digital Microscope	84	16	78	22	To see an accurate microscopic. The students enjoy using the digital microscope.
Digital Projector	34	66	31	67	Saves time, enjoyment, motivation, interaction, and information is easily accessible to students.
TV Monitor/VCR/DVD Player	54	46	49	51	Saves time. Presents something new. Pulls the students’ attention.
Digital Camera	77	23	77	24	Documents experiments built in the laboratory.
Printers	45	55	51	49	Prints subject materials.
Portable Computer Units	84	16	78	22	Access to the Internet.
Laptop for Teacher Use	62	38	38	62	Prepare lessons, access to the Internet. Present structure of experiments in the laboratory.

Teachers were asked (question 13, see Appendix 1) to specify one example they had implemented in their science teaching using ICT tools. Different examples of the use of ICT from their experiences were given. For example, Biology teachers said:

I had used the ‘digital projector’ to present the prepared lessons which included life pictures related to my subject ‘Biology’, video clips and flash by using the PowerPoint programme to enhance lessons. (ARMC F-23)

I used the ‘digital projector’ to describe the human body clearly by using colour. This had the effect of focusing student attention and facilitating interaction. (GOVR F-12)

I used the ‘digital projector’ to display marine organisms. (ARMC F-19)

I used the ‘digital projector’ to display a lesson of classification through the PowerPoint programme that included pictures, sound effects and the assessment and evaluation as well as multiple choice questions. (ARMC M-126)

I used the ‘digital projector’ to display an interactive quiz on the ‘plant kingdom’ using PowerPoint and also I completed the correction of answers in open presentation. (GOVR/R M-100)

These Biology teachers also showed their ability in using high technology tools like ‘digital microscope’ and ‘digital camera’:

I used the ‘digital microscope’ to illustrate cells and check specimens. (GOVR/R F-16)

I used the ‘digital camera to take photos of practical applications from environment applications like the study of the temperature variation of soil, weather and water. (GOVR M-61)

Teachers also used different tools like ‘laptop’ and they indicated their examples:

I used my ‘laptop’ to prepare a lesson on the human body, blood coagulation and chromosomes and then I used the digital projector to display the full presentation. (GOVR/R F-15)

Other female Chemistry teachers used the ‘digital projector’ for specific duties:

I used ‘digital projector’ to illustrate electricity cells [Daniel Cells] and create the relationship between them. (GOVR/R F-13)

I used the ‘digital Projector’ to display the Ionian association, a video clip for the Ionian association and the lesson summary. (GOVR F-75)

Physics teachers used ICT tools to conduct experiments:

I used the ‘digital projector’ in my subject to contrast and clarify systematic and regular reflection and let the students compare different aspects of causality. (GOVR F-5)

I used the ‘laptop’ to present electricity cycles and the best ways of connecting them. (GOVR M-72)

From the quotes above it can be seen that at the secondary school level, teachers are able to use different forms of ICT to enhance the teaching and learning when that tool is available to them. Teachers were also aware of the benefits of the use of ICT in their subjects believing this can improve their lessons, focus interest and enable alternative teaching methods. As they stated in their comments:

ICT tools will improve education methods and we will gain benefits if we use these tools and that will help us to simulate real life scenarios when we teach our science subjects. (GOVR F-37)

They will develop students’ cognitive skills as well as a sense of pride in their school and community. (GOVR F-50)

With the use of ICT tools we will discover new ways of teaching. (GOVR M-110)

Implementation of ICT activities

This section is an analysis and discussion of the ICT questionnaire responses to question 14 (see Appendix 1). Different forms of activities were itemised to investigate how often science teachers use ICT tools to enhance teaching and learning. The teachers were asked to describe their implementation of 16 forms of

ICT activities listed in Table 4.11. This table shows the frequency of the chosen activities. Their responses were scored as follows: several times a week, several times a month, several times a year, once or twice a year, and never.

The responses for this question showed that teachers were comfortable using ICT tools with different activities to enhance teaching and learning. Teachers also appeared to be at ease with using ICT tools to develop science lessons by designing informative PowerPoint, Web pages, flash animations, and digital video productions, which showed the highest percentage of their responses (73 %). This question may have provided misleading responses as perhaps they were just using PowerPoint. One female teacher noted that:

We need to learn how to plan and prepare our lessons by using software programmes such as Flash and Microsoft Office. (GOVR/R F-17)

Most of the science teachers in this study (68 %), stated that they were using ICT tools at least once or twice a year to perform activities such as creating an interactive science test and quiz to improve their students' perceptions of science subjects. The delivery of instructions to science classes by using ICT tools was another activity that teachers used to enhance teaching and learning as around 65 percent of them were active in this area.

The remainder of the activities, which probed frequency of usage involving more recently introduced tools such as 'digital microscope' 31 percent, 'web-quests' 33 percent, 'sensors' 41 percent, 'games show review' 46 percent, 'data-show' 46 percent and 'create models' 50 percent, indicated that over half of them did not use these activities (Never). The responses of 'Never', could well be the result of the total absence of such tools within their schools and not an indication of lack of interest or ability in using them. One female teacher noted that:

We need to be supported with ICT tools as there is a shortage of these tools in our school. (GOVR F-2)

Table 4.11

Frequency of Teachers' Use of Activities (Values shown as %)

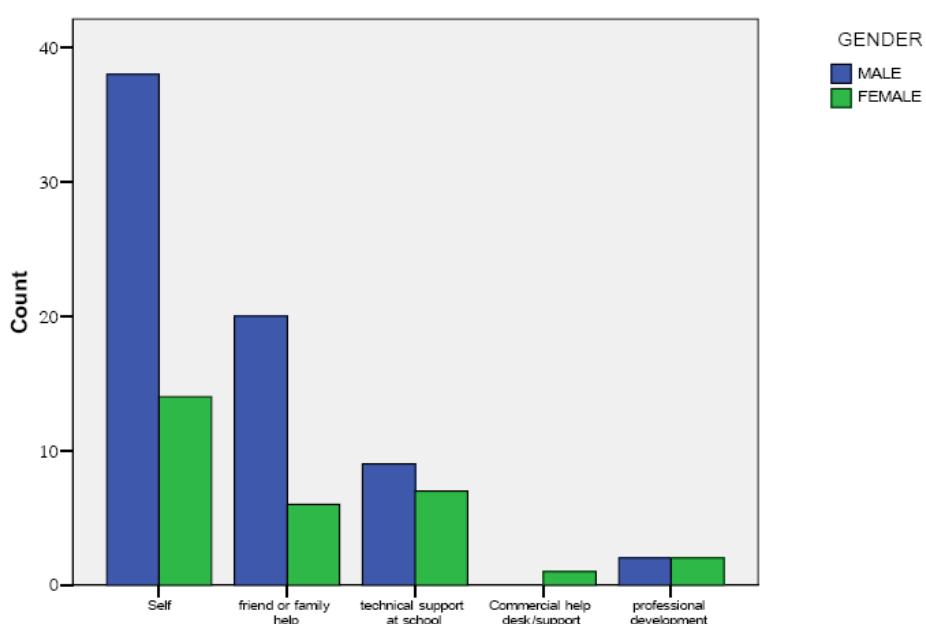
Activity	Several times a week	Several times a month	Several times a year	Once or twice a year	Never
Using a computer to deliver instruction to science class.	23	18	15	10	35
Using Digital Microscope to conduct experiments in science and check specimens.	14	6	6	5	69
Using the data show and sensors to display data and virtual science experiments.	17	9	10	10	54
Using sensors to measure physical changes (e.g. temperature).	13	14	7	7	59
Using digital camera to create video clips of some scenes (e.g. from plants' and animals' environment) to prepare samples, discover the plants'/animals' lives and to explain science phenomena.	10	9	10	6	65
Using ICT tools to prepare students to observe, hypothesize, experiment, theorize and publish results.	16	15	17	12	39
Making dissection of animals (e.g. Rat) to show its internal organs using ICT tools.	8	10	7	9	66
Creating models resembling the original, using ICT tools and encouraging and motivating students to do so.	13	13	11	12	50
Developing science lessons by designing informative PowerPoints, Web pages, flash animations, and digital video productions.	19	21	22	11	27
Creating/using science animated cartoon presentations that demonstrate real world interaction by using specific programs.	18	5	8	7	62
Creating web-quests (e.g. live Web conferences) providing lessons relevant to science subjects for all guests, or building the internet into a lesson.	13	4	5	8	67
Data handling (using spreadsheets and graphing software to analyse data).	16	15	10	7	51
Using games show review; for encouraging students to recall information in a competitive environment.	15	12	8	11	54
Performing research and lesson planning using the internet browsers, multimedia CD ROMs.	18	15	16	8	42
Creating interactive science tests, quizzes and other assignments by using interactive learning modules to improve students' conceptions in their science subjects.	12	20	26	10	32
Simulation (virtual experiments and visual aids, simulating and helping to explain phenomena).	12	14	16	15	43

4.2 Professional Development (PD)

This section, discusses the responses when teachers were asked to indicate the impact of the Professional Development in ICT on their teaching and learning (see Appendix 1). In terms of ICT skills and knowledge, what do Saudi secondary school teachers think are their needs for improving the use of ICT use in the classroom?

Figure 4.8 (below) shows the ways teachers learn how to use ICT tools in the classroom. There are five different ways: self, friend or family help, technical support at school, commercial help desk/support and professional development. Most teachers had learned how to use ICT tools by themselves, male teachers also learned from family or friends (more so than female teachers). A few female teachers had used commercial help desk support but no male teachers indicated they had used this source.

Figure 4.8
Teachers' ways of learning how to use ICT tools



Teachers were asked to indicate if they had attended any professional development. The analysis of the data displayed some interesting facts regarding teachers' PD.

Most of the science teachers (85 %) from different subjects did not participate in any PD from their schools or even from the Ministry of Education.

The survey, in addition, asked them to identify their preferred learning topics in a PD environment. Their responses were divided into two fields: software and hardware programs. Most of these teachers wanted to learn specific programs such as, Data base, Front page, Java, 3D MAX, Website designing, Flash and access to the Internet.

A lesser number of teachers wanted to learn about hardware devices that were provided to their schools such as the interactive whiteboard, the digital microscope and digital camera, and how to integrate those tools into their subjects. Furthermore, one teacher noted that:

I want to learn a practical program such as dissection of animals using ICT tools. (GOVR M-57)

The survey asked teachers about their perspectives on ICT, (question 28, see Appendix 1). Participants were required to specify what things might help them to develop their practice of using ICT to support teaching and learning in science. The following section reports on the results of the analysis.

Teachers suggested that more training (PD) in ICT was needed to help the process of integrating ICT into classroom practice in order to develop understanding and confidence in the use of ICT in the classroom. Sixty-eight percent indicated that the biggest fear of using these new technologies is losing control of the classroom. Three female teachers agreed with teacher (GOVR F-13) who commented:

The huge number of the students in each class could mean the teachers lose control when using ICT tools in both classroom and laboratory. (GOVR F-13)

While another female teacher said:

Involve all the new science teachers in an extensive training programme so they can help themselves develop and practice using ICT tools to support teaching and learning in science. (GOVR/R F-17)

Teachers also added that more time was needed to come to grips specifically with computers before learning about the ICT area. The suggestion here was to support these teachers to develop the practice of using ICT tools, through such methods as funding, providing science materials, tools and rewards and also solving the shortage of science teachers in some schools. Ongoing maintenance for ICT tools and keeping teachers up to date with the new science information would be very helpful. One teacher commends:

We need to see maintenance for the ICT tools that are provided and to be sent ongoing information about how to use ICT tools through the emails. (GOVR M-89)

Because of Saudi customs and culture, female teachers need support from their family to attend training programmes if outside school or far away from their home location, as some families did not allow their girls to spend much time outside home, especially after school time, unless on issues of immediate urgency. One female teacher noted that:

I need motivation and permission from my family to attend things like these PD programmes. (GOVR F-12)

The more significant problem for science teachers was the shortage of the resources for science subjects at schools. As they noted:

We need extensive resources provided to our school, such as Internet resources, foreign resources, expert websites of how to integrate ICT tools into education, electronic curricula on CDs as what we have now are not interactive curricula, just PDF files. (GOVR M-56)

Additionally, and related to the comment by GOVR M-56 above, there was a suggestion made by some female teachers of creating a resource centre, including all resources that are related to science subjects.

Teachers also asserted their need to have ongoing classroom support, including ICT tools. An infrastructure such as the laptops for teachers and students inside the laboratory and both Internet and Intranet networks in each classroom were needed as well.

Science teachers, both female and male, believe that working with other teachers from other districts in the same subjects would increase and develop their practice of using ICT. Having conferences, whether face-to-face or online, from time to time for science teachers and between experts in science to refresh information, learn new knowledge and share their experiments with each other would encourage them to develop their science subjects.

I would like to see online conferences between science teachers and experts in science to benefit from their experiences. (GOVR/R F-17)

We would like to share experiments with other science teachers inside and outside school. (GOVR M-114)

These teachers wanted workshops of three kinds: practical workshops, workshops with science case studies, and workshops with ongoing follow-up. All of the workshops, to be helpful for science teachers, needed to be funded by the Ministry of Education. Teachers stated that:

I need to see support for our schools by substantial funding for practical workshops. (GOVR F-4)

Such expressed desires translated into a need to be practical with prepared materials, not just theory, and for the workshops to be provided through an organization or college with an established reputation for professionalism and competency. Of equal importance was the need expressed by participants for follow up from the Ministry of Education, who would check with principals of schools to evaluate these workshops on a frequent basis. Teachers commented:

We need to see the supervisors or inspectors from the Ministry of Education to follow up with schools doing these workshops. (GOVR F-35)

Teachers also were asked their preference for the format of PD workshop delivery. Teachers who had previously taken PD programmes were aware of four delivery channels: external training provider; e-learning [online training]; in-house training, and university/academic institution. According to that nearly 40 percent had taken their PD through in-house training and a university/academic institution.

The analysed data (question 18, see Appendix 1) regarding who delivered the PD for the teachers showed that 78 percent of teachers did not indicate any response to this question, suggesting that they may not have attended any PD. However, of those who responded to this question were 12 teachers who had taken their PD as in-house training and 11 teachers who had taken it through a university/academic institution. The rest of teachers had taken their PD through e-learning/online training (three teachers), external training provider (two teachers) and other ways (one teacher). This data differs to participant responses shown in Figure 4.8.

Most teachers who indicated their responses (12 male; 6 female) noted that the PD that they had taken had a positive impact on their teaching. And they were also asked

to specify why the PD was successful for them. While the response of many teachers reflected a consistent reasoning, that it helped them with their lessons:

Yes, the PD was successful for me because I was able to make a presentation for my lesson (GOVR F-5)

and

Yes, it was successful PD as it helps me a lot to deliver the lesson to the students by using ICT tools (GOVR F-11),

one teacher, however, said:

The PD that I took was not particularly valuable to me because, the teacher who trained us was not professional and in my opinion the Ministry of Education or the organizer for this program should provide a team who are expert in ICT tools. (GOVR M-86)

However, some teachers, (male 15 %; female 15 %) who had undergone PD programmes covering several topics such as PowerPoint , Internet access and Photo Shop, asserted that most of these programmes were not useful for them for two reasons. Firstly, that they were not practical and secondly, that they do not have these tools in the classrooms. As one teacher said:

I attended PD program on ICT area and that program covered learning and teaching technology programs and how to use an interactive whiteboard. However, the programs were just theoretical not practical. Furthermore, the amazing thing was that we do not have these tools at our school. (GOVER F-31)

Teachers who did not take any PD in ICT were facing many problems that discouraged them from using ICT to enhance teaching and learning. Table 4.12 (below) summarizes the factors that were seen by 131 science teachers out of 200 teachers (86 male: 45 female) as prohibiting their use of ICT. Lack of PD available

for them was the main problem given by science secondary teachers both male and female for not using ICT tools (male 32 %; female 30 %). Teachers were also burdened by other duties and responsibilities as 18 percent of males and 30 percent of females indicated. The limited time that was available for teachers (male 18 %; female 10 %) to take PD programs was another factor that could inhibit teacher involvement in any PD programme in ICT development.

Table 4.12
Barriers that teachers have encountered (Values shown as %)

Which of the following barriers have you encountered?		Count	GENDER		Total
			MALE	FEMALE	
Little or no encouragement from school management	Count	8	1	9	
	% within GENDER	16.0%	10.0%	15.0%	
Lack of PD	Count	16	3	19	
	% within GENDER	32.0%	30.0%	31.7%	
Limited time	Count	9	1	10	
	% within GENDER	18.0%	10.0%	16.7%	
other duties/responsibilities	Count	9	3	12	
	% within GENDER	18.0%	30.0%	20.0%	
resourcing	Count	7	2	9	
	% within GENDER	14.0%	20.0%	15.0%	
other	Count	1	0	1	
	% within GENDER	2.0%	.0%	1.7%	
Total	Count	50	10	60	
	% within GENDER	100.0%	100.0%	100.0%	

Other barriers have also prohibited these teachers undertaking PD in ICT. As one teacher commented:

The burden of domestic and family responsibilities is a significant diversion for female teachers, with a negative impact on their rate of growth in the skills of using ICT tools. (GOVR F-40)

And, the shortage of ICT tools, resource rooms and laboratories with fully equipped ICT technologies, might be a big problem. (GOVR F-42)

On one hand, in Aramco schools, the main reason for not using ICT tools, given by male teachers is because of the lack of PD provided for them. The next reason was little or no encouragement from school management, without release from other duties/ responsibilities. On the other hand, female teachers' reasons for not using ICT tools, placed the emphasis on other duties/responsibilities and limited time, rather than lack of PD.

For small schools in rented premises, female teachers' reasons for not using ICT tools fluctuated between lack of PD, little or no encouragement from school management and limited time. By contrast, male teachers' responses for not using ICT tools were concentrated on the lack of PD programmes provided to them. One teacher commented:

There is a shortage of PD programs provided for teachers and what is provided does not cover special tools such as the ‘sensors’. (GOVR/R F-16)

Teachers were also asked (in question 21 and 22, see Appendix 1) who had overcome these barriers to using ICT tools and how they had done so. Responses showed that 23 percent of teachers had used different ways. These different ways were trial and error, using Internet and accessing other schools' examples to become knowledgeable in the use of ICTs and to overcome these problems. Their comments were:

Actually, I did that through trial and error until I identified many things I had not known before. (GOVR F-5)

In a rented school, one female teacher stated that:

I did not receive any help from the Ministry of Education. So I helped myself by accessing the Internet, asking my friends and my family members and reading books that talked about how to use ICT tools. (GOVR/R F-17)

One female teacher acknowledged a foreign experiment and she said:

I tried hard to find time while I was at school to see what Canadian schools had done to improve their education by integrating ICT with their curriculum. (GOVR F-40)

Other teachers who did not have ICT tools available in their schools and who did not receive any PD for ICT said:

I bought a laptop and a digital projector myself and I practiced using these tools. Then I used them daily in both my classroom and the laboratory to motivate students and let them collaborate with each other to prepare lessons by using ICT software like the PowerPoint program. (GOVR F-42)

One male teacher noted that:

In fact, we have a resources room but unfortunately it was closed and no one was using it. So, I opened it and restored it so that we could practice using resources and helping each other as science teachers as well as getting help from other teachers who were familiar with ICT tools. (GOVR F-75)

The survey also asked those teachers who overcame the barriers to specify how successful that was for them. The teacher who bought the laptop and digital projector herself, said that:

It was very helpful as it enabled me to provide models resembling the original. And the students became impassioned with their subject. (GOVR M-42)

However, some teachers were not satisfied enough with what they did through trial and error to learn how to use ICT tools, and they did not notice any difference. As one said:

What I did to overcome the problem of the use of ICT was perfunctory and not specialised enough and in the near future I hope to get a chance to attend a PD program in ICT to improve my subject skills using these tools. (GOVR F-5)

A teacher who conducted her own PD, said that accessing the Internet and asking his friends was of only marginal value:

I had limited success because the PD for ICT that I got through different resources was theoretical not practical. (GOVR F-17)

Although many teachers had minimised the problems that they had been facing through personal effort, they thought there were still major challenges to overcome in the use of ICT tools. These challenges can be divided into two categories: those for students and those for teachers.

Teachers' perspectives on the problems that schools might face using ICT with students were largely focused on management of large numbers of students and potential damage to tools from students. Teachers commented that:

As classes in some rented schools have 35 students or more, behaviour management and control in the use of ICT tools is significantly undermined in both the classroom and the laboratory. (GOVR F-13)

Most of the students were unaware of the importance of ICT tools. Therefore, they did not value these tools and as a result these tools are frequently corrupted or destroyed. (GOVR M-85)

Furthermore, teachers commented that the content of the curriculum was frequently difficult to adapt to an ICT format and that inadequate funding was a core issue:

The content of the curriculum is not organised or designed to facilitate ease of implementation with the use of ICT tools. (GOVR F-36)

Other teachers said:

The school's unwilling to provide the new technologies from their basic funding. So, more funding is needed from the Ministry of Education. (GOVR F-38)

The data from the survey analysed indicated a positive impact from teachers' approach to ICT in the classroom. Science teachers' responses of what they thought would be the greatest gain for the schools if they use ICT tools effectively were encouraging.

These teachers believe that if students could learn to use ICT tools effectively, this would result in improving student learning, changing study methods, improving students' attention, and improving their critical thinking, and greater understanding through observation, analysis and investigation. Teachers commented that:

It will improve their capabilities and learning and develop their knowledge and enable them to keep abreast of developments in the world. (GOVR/R F-16)

Another teacher said:

They will gain more understanding and they will increase their power of observation, analysis and investigation. Also, motivation will increase when they work together in groups using ICT tools. (GOVR/R F-17)

Other teachers thought that the greatest gains would be achieved by teachers accessing the Internet, sharing knowledge between teachers in the same subjects, and changing methods of teaching. Teachers commented that:

Through the accessing of the Internet, we will gain more communication with other teachers who are in the same field to increase our knowledge and get information from other resources away from the book curriculum. (GOVR F-25)

We will be able to create opportunities for different ways of teaching by accessing the Internet and using ICT tools. (GOVR F-42)

We will secure information faster when we use the Internet and be able to present our lesson with greater ease. Also, we will be able to communicate with others in simple ways and keep up to date with new innovations in ICT tools. (GOVR/R F-15)

However, there was the opinion emphasised that the use of ICT tools would inevitably result in a decrease of other literacy. One teacher said:

While we will become fully aware of the importance of ICT tools and how to use them, this will be at the expense of technical literacy. (GOVR M-89)

4.3 Beliefs about ICT

In this section Saudi secondary school teachers were asked to indicate their perceptions of and beliefs about the use of ICT to improve teaching and learning. This section will examine the rating of teachers' agreement with themselves about ICT; teaching by ICT; PD for ICT, and the barriers of ICT. The most valued tools of ICT for teachers will be indicated. In addition, this section will identify teachers' responses to the importance of teachers' improvement; students' improvement; access to the Internet and others.

The science teachers' attitudes towards ICTs are shown in the following Tables 4.13, 4.14, 4.15 and 4.16 using a five point scale with "tick the box" of strongly agree, agree, not sure, disagree, or strongly disagree. Participants were required to tick only one box containing the statement that best expressed their beliefs. This section reports on the results of the analysis.

Table 4.13
Rating of teachers' agreement to beliefs about ICT (Values shown as %)

Question	Strongly agree	Agree	Not sure	Disagree	Strongly disagree
I have made progress during the past year in learning new ICT software.	10	32	26	18	14
I have made progress during the past year in introducing new ICT into my science classroom.	8	25	23	29	15
My biggest fear of using these new technologies is embarrassment in front of my students.	8	13	7	38	34
My biggest fear of using these new technologies is embarrassment in front of my colleagues.	8	12	7	37	36
My biggest fear of using these new technologies is losing control of the class.	8	10	14	34	34
I have put a lot of extra time and effort into keeping up with ICT developments in our school particularly with science tools.	17	27	22	22	12
I feel frustrated when I see the potential of ICT but do not have the time to spend working with it.	19	42	13	17	9

Table 4.13 showed that teachers appeared to be not concerned with being embarrassed in using new technologies either in front of their students (72 % disagreeing or strongly disagreeing), or their colleagues (73 % disagreeing or strongly disagreeing). Losing control of the classroom was not a concern for teachers if they use ICT tools in their classroom as around (68 %) did not fear this. However, a number (61 % strongly agree or agree) found themselves frustrated because they find it hard to find the time. As one female teacher said:

I try hard to find time while I am in my school to access the Internet and see how the Canadian schools work with integrating the use of ICT tools in the science classroom (GOVR F-40).

Table 4.14

Rating of teachers' agreement with teaching by ICT (Values shown as %)

Question	Strongly agree	Agree	Not sure	Disagree	Strongly disagree
Most of the ICT that has been shown to me would do little to improve my student's ability to learn, investigate, explore, observe/watch, do experiment, represent, access to digital science resources and etc.	29	32	9	17	13
I have integrated ICT use to such an extent that I am not sure what I would do now if the ICT and programmes were suddenly unavailable for my science classroom.	10	15	28	33	14
The new ICT we have available in school has caused me to change the way I teach.	23	32	15	18	12
The new ICT has caused me to change the way I relate to the students.	21	30	20	20	9
I have begun to enjoy teaching more than ever because of the new ICT capabilities available for science teachers.	26	34	15	12	12
I am ready to share the science teaching resources I have developed using ICT with other teachers.	30	32	17	12	8
There is very little evidence to support the benefit for student learning of the integration of ICT in the science classroom.	7	30	27	23	13
I have begun to enjoy teaching science subjects using ICT more when I see the students' positive reactions.	30	39	14	8	8
I think that students using ICT learn more about the tool than the science subject content.	25	40	14	15	6

Table 4.14 illustrated teachers' agreement with teaching by using ICT tools. Science teachers in this study reported that they had enjoyed teaching their subjects using ICT tools, particularly when they saw their students' positive reactions (strongly agree 30

%; agree 39 %). The teachers were also motivated to share with other teachers the science teaching resources that they had developed using ICT (strongly agree 30 %; agree 32 %).

And they have no doubt that students' abilities to learn, investigate, explore, observe/watch, do experiments, represent, access digital science resources etc., would improve by using ICT (strongly agree 29 %; agree 32 %). Teachers commented on that:

Integrating ICT tools with science subjects will increase competition between students in learning how to use these new technologies. (GOVR F-42)

Teaching science using ICT tools proved to be an exciting experience as many enjoyed using these tools to develop teaching and learning (strongly agree 26 %; agree 34%). The change of an innovation being implemented increases with the level of personal commitment to making that change by the individual involved. As this study showed, teachers were able to change the way they teach. Furthermore, some were able to change the way that they related to the students (strongly agree 21 %; agree 30 %).

However, the uses of ICT were not always seen as beneficial to everyone by these participants. Some teachers assumed that, when they were using ICT, students learned more about the tools than the science subject content while the aim to enhance teaching and learning depended on the use of ICT tools (strongly agree 25 %; agree 40 %).

Table 4.15

Rating of teachers' agreement with PD for ICT (Values shown as %)

Question	Strongly agree	Agree	Not sure	Disagree	Strongly disagree
The best way to learn new things is to take part in a training course.	50	26	4	8	13
Sometimes I feel that there is just too much change coming too fast.	26	32	19	9	13
I sometimes feel I have been left behind when it comes to ICT.	8	20	28	28	17

In this research result there was evidence of the shortage of PD programmes being provided for science teachers in Saudi secondary schools, with approximately 85 percent of science teachers who did not take any PD. Table 4.15 rates teachers agreement to statements relating to their own professional learning in ICT. The questionnaire responses indicated that science teachers from different subjects believed that the best way to learn new things is to take part in a training course, as most of them were agreed on that (strongly agree 50 %; agree 26 %). However, other teachers (strongly agree 26 %; agree 32 %) felt that there was just too much change coming too fast for them. A lesser number agreed or strongly agreed (28 %) that they sometimes felt left behind when it comes to ICT.

Teachers were also asked to indicate their rating of agreement with statements regarding more time and more pay being required for teacher development in ICT. Table 4.16 shows that teachers were not concerned with gaining more time from their schools to learn about ICT software. Forty one percent strongly agreed or agreed that without increasing their salaries from the Ministry of Education, the school should not expect them to learn all this new ICT software.

Table 4.16

Rating of teachers' agreement of the barriers of ICT (Values shown as %)

Question	Strongly agree	Agree	Not sure	Disagree	Strongly disagree
The school cannot expect us to learn all this new ICT software unless they give us more time.	7	17	17	30	28
School cannot expect us to learn all this new ICT software unless they give us extra pay.	17	24	22	23	14

The survey asked teachers (in question 29, see Appendix 1) to identify which ICT tools would be of most value to them. Table 4.17 (below) shows that some secondary school science teachers (male 55 %; female 48 %) suggested that the laptop for personal use might be the most valuable tool for them. It was also found that these teachers believe a desktop computer in classroom would encourage teachers and students (male 13 %; female 33 %), while only a few teachers (male 19 %; female 5 %) believed that one desktop for each student in a lab will be of value to them.

Table 4.17

The most valuable ICT tools for science teachers

		GENDER		Total
		MALE	FEMALE	
Which one of the following ICT tools would be most valuable to you?	Laptop for personal use	Count	34	44
		% within GENDER	54.8%	53.0%
	A desktop computer in your classroom	Count	8	15
		% within GENDER	12.9%	33.3%
	one desktop for each student in a lab	Count	12	13
		% within GENDER	19.4%	4.8%
	A mobile cart with one wireless laptop	Count	8	11
		% within GENDER	12.9%	14.3%
Total		Count	62	83
		% within GENDER	100.0%	100.0%

Additionally (in question 30, see Appendix 1), teachers were asked to identify the relative importance of fifteen different elements in the contribution to enhancing quality of teaching. Their responses were categorized into four groups: teacher

improvement; student improvement; access to the Internet, and others. The results are as shown in Tables 4.18, 4.19, 4.20 and 4.21.

Table 4.18

Teacher responses to the importance of teachers improvement in ICT (Values as %)

Element	very important	somewhat important	slightly important	not important
Using ICT to improve science teaching.	84	10	6	0
Improving teacher productivity and efficiency in science using ICT tools.	76	20	4	0
Increasing teacher proficiency in use of ICT in science.	80	15	4	1

Table 4.18 shows that these teachers stated that using ICT to improve science teaching is very important (84 %). A further 80 percent responded that increasing teachers' proficiency in use of ICT in science is very important as well.

Table 4.19

Teachers' responses to the importance of students' improvement from ICT (Values as %)

Element	very important	somewhat important	slightly important	not important
Improving students' test scores in science subjects.	60	27	12	1
Improving students' proficiency in science methods.	72	19	9	0
Improving students' proficiency in data analysis.	48	31	17	2
Using ICT to improve student learning in science classroom.	65	23	13	0
Improving students' proficiency in team work and collaboration.	69	23	8	1
Improving students' computer skills and abilities.	77	19	3	0

Approximately 77 percent of the respondents believed that the use of ICT is very important to improving students' computer skills and abilities. And 76 percent of teachers believed that ICT tools are very necessary to students' productivity and efficiency in science subjects.

Furthermore, the use of ICT, from science teachers' perspectives, would improve the students' proficiency in science methods, as 72 percent of teachers stated that this element was very important. So the use of ICT is regarded as very important for both teachers and students. Science teachers believed that the use of ICT would improve students' grades, their learning in the classroom, and proficiency in team work and collaboration.

Table 4.20

Teachers' responses to the importance of access to the Internet (Values as %)

Element	very important	somewhat important	slightly important	not important
Access to expertise online	67	22	10	1
Access to up-to-date multi-media resources.	66	25	7	2
Increasing student/computer ratio.	57	28	6	7

Table 4.20 shows that the access to expertise online and access to up-to-date multi-media resources for science subjects were very important for science teachers.

Table 4.21

Teachers' Responses to the importance of other elements of ICT (Values as %)

Element	very important	somewhat important	slightly important	not important
Promoting active learning strategies in science.	73	20	6	1
Satisfying parent and community interests.	64	20	10	3
Preparing students for future jobs.	69	23	7	1

The majority of participants (73 %) indicated that ICT for promoting active learning strategies in science was very important. Additionally, it is very important in satisfying parent and community interests. Also, it would prepare the students for future jobs.

These findings indicate that teachers have no trouble identifying benefits from the use of ICT for teaching and learning in science.

The final question asked science teachers if they are aware of their school's policy for the use of ICT in their schools. The research found that 46 percent of science teachers were somewhat aware of their school's policy. Unfortunately, more than 25 percent were not aware of the policy for the use of ICT in their schools. Girls' schools were found to have the lowest number of teachers who were aware of their school policy, only 2 female teachers out of 45 female teachers (4 %); while the boys' schools were found to have greater awareness than girls' schools as around 11 teachers from the three different schools stated that they were well aware of their policy (14 %).

4.4 Summary

This study sought to know and understand the impact of the current use of ICT on teachers' behaviour in using ICT tools to enhance teaching and learning, the importance of ICT professional development (ICTPD), and their behaviour, attitudes and beliefs towards ICT.

The findings in this research showed that the most common ICT tools that were available at schools were the 'digital projector', 'printers', 'TV monitor/VCR/DVD player' and 'overhead projector', as over half of the teachers have these devices in their schools. The science teachers in this study indicated which specific ICT tools they used from the tools that were available to them at their schools. The most used of these tools were the 'digital projector', 'printer', 'TV monitor/VCR/DVD Player', 'overhead projector' and 'laptop for teachers' use'.

The results overall indicated that approximately half of the participants were still in the evolutionary stage in their use and application of various ICT tools. Notably however, the other half had made significant gains in both knowledge and the skills needed, to integrate these tools into their individual disciplines of physics, chemistry and biology. This success was largely achieved through personal application in learning how to use the new tools as well as other personal initiatives that enabled their knowledge growth.

However, it is important to note that those teachers encountered significant barriers and limitations that impacted on their ability to apply these tools in the classroom. These limiting factors divide into five main areas of concern, which follow in declining order of negative impact: the absence of professional organised PD programmes within the school schedule (32 %); the imposition of other traditional duties and responsibilities, (20 %); limitations of time (17 %); inadequate preparation and resourcing (15 %); and a lack of encouragement and motivation from school management (15 %).

In broad terms, this study demonstrated what science teachers considered to be the most significant challenges. These were divided into two categories, those for students (large number of students and potential damage to tools from students) and those for teachers (the content of the curriculum is not designed to facilitate ease of implementation with the use of ICT tools) they and their schools face in the implementation of ICT tools in their subject disciplines. The survey also revealed that the respondents considered there was much to be gained from the effective integration of ICT. A discussion of these findings and the literature to answer the research questions will be presented in Chapter 5.

CHAPTER 5

DISCUSSION

5.0 Introduction

This chapter will focus on the discussion of the results from the investigation of Provincial Saudi secondary school science teachers' perceptions of the use of ICT tools to support teaching and learning. This chapter is divided into four sections: Section 5.1, teachers' current use of ICT; Section 5.2, professional development, 5.3, teachers' beliefs about ICT, and Section 5.4, summary of this chapter. The objectives of this research project were to investigate Saudi science secondary school teachers' current use of ICT, their beliefs about the benefits of ICT and what they perceive their needs are for improving ICT use in their classrooms.

To recap, the questions guiding the research are the following:

- 1) In what ways do Saudi secondary teachers use ICT?
- 2) In terms of ICT skills and knowledge, what do Saudi secondary school teachers think are their needs for improving the use of ICT use in the classroom?
- 3) What are Saudi secondary school teachers' current perceptions of ICT?

5.1 Current Use of ICT

In this section the current use of ICT tools available for teachers who participated in this study will be discussed under the sub-headings of ICT tools most used in schools and applications of the use of ICT tools.

This study found that most of the science teachers who participated in this study (92 %) have either a desktop or laptop personal computer and that was clear evidence of the awareness of the importance of the use of ICT tools in the science classroom. More than half (52 %) of the teachers in this study considered their abilities to use ICT tools as at intermediate level, and approximately 41 percent at beginner level and only 7 percent at expert level. This suggests that only a few science teachers thought

they had become experts on the use of ICT tools and knew how to integrate these tools in the science classroom. However, that does not mean the other teachers did not know how to use the ICT tools or integrate them into their classroom, as around half of them (52 %) saw themselves in the second level (Intermediate) and that is perhaps because they have owned their personal computer for six to ten years and had become familiar with it. It was clear that the desire of changing from a traditional way of teaching to the new way which depended on the use of ICT tools to enhance teaching and learning was the reason (see Section 2.2 Teachers' Use of ICTs, p.19). Literature also shows that teachers anticipate the promise of empowerment through the applications of ICT in education as innovations impact at speed and expand knowledge horizons and skills competency. ICT has given opportunity for science teachers to develop and enhance teaching and learning (Becta, 2008).

ICT tools most used in schools

The findings of this study showed that the ‘digital projector’, ‘printers’, ‘TV monitor/VCR/DVD player’ and ‘overhead projector’ were the most common ICT tools that were available at schools as over half of the teachers have these devices in their schools. In general, the Ministry of Education have devoted their efforts to providing schools with different types of ICT tools, particularly tools such as, ‘digital projector’, ‘printer’, ‘TV/monitor/VCR/DVD Player’ and ‘overhead projector,’ that help all the teachers in the schools whatever their subjects. By contrast, the high technical tools such as ‘digital microscope’, ‘digital camera’, ‘interactive whiteboard’, ‘portable computer units’, ‘laptop for teacher use’, ‘classroom computer for teacher use’, ‘student computers in a lab’, ‘student computers in classroom’ and ‘scanner’ are less accessible or unavailable to science teachers.

The results of this study have shown that the science teachers’ current use of ICT across all subjects (Physics, Chemistry and Biology) in all different types of schools (public, rented and Aramco Company schools) were limited in the use of some tools such as ‘digital projector’. A high percentage of teachers (70 %) used this at least once per week, other teachers used it three times a week, and some used it daily. It

seemed that these tools were easy to use and teachers were familiar with them. Saudi Arabia is just one of many countries that have provided teachers at schools, especially science teachers, with different types of ICT tools to help improve their skills in using these tools and to enhance their teaching and learning as well.

Dawson et al., (2006) indicated that science teachers in Australia, for example, were provided with different types of ICT tools in the science classroom to enhance teaching and learning. Hardware such as digital cameras, data projectors, laptops, electronic overhead projectors, electronic whiteboards, software such as interactive CDs, interactive applets, simulations, electronic portfolios self-based online modules and websites for teachers and students.

Applications of the Use of ICT Tools

Administration

In the findings of this study, teachers use ICT tools for administrative tasks such as recording student science grades (60 %), writing student reports (44 %) and checking student science lists (27 %). For instance, many teachers indicated they used ICT tools for writing student reports. A very high level of use among teachers was found in recording student science grades. Some uses of ICT tools that fewer participants indicated using were checking student science lists or checking school timetable or notices (27 % - 21 %). Science teachers recognized that the ICT tools are useful tools that can support them in administration. The research of Cowie et al. (2008) also noted similar findings in that ICT tools such as laptops were using from the majority of science teachers for writing reports for parents, recording and checking students' data.

Communication

Hawkins (2002) noted that using ICT tools correctly, in and out of the classroom, can increase communication and collaboration between teachers in and out of school, between teachers and students and between students and students. The findings of this research are consistent with this as around 63 percent of the respondents

indicated that they use the ICT tools for communication tasks such as accessing the Internet for seeking information, professional reading, subject association news, etc. The next highest proportion was contacting colleagues via email to increase their knowledge, then participating in online discussion lists and collaborative development of units. Cowie et al. (2008) found that the use of ICT tools such as laptops had increased the communication between all the stakeholders in and out of class time. Sharing work together, for example, students can engage with teachers' lesson materials in different ways and teachers can share teaching notes and exemplary work with students via CD and email. Not just that, students skills and experiences have also been improved when working as a group around a computer or using ICT tools.

In fact, science teachers in this study both female and male were interested in using their own laptops or school computers to access the Internet for seeking information, professional reading, subject association news, etc., as nearly all teachers (92 %) had a personal computer. Around a third of the teachers (29 %) wanted to increase their knowledge through using online sources, whether it was from teachers who were in the same subject or from websites related to their subjects, which was clear evidence of the changing of teachers' thinking. Most of them (84 %) had come to a fuller understanding of the importance of the use of ICT tools, stating that using ICT to improve science teaching is very important to enhance teaching and learning, to increase their knowledge and benefit from the experiments of others. For example, one participant specified that they try to find time while they are in their schools to access the Internet and see how the Canadian schools work with integrating the use of ICT tools in the science classroom (GOVR F-40).

The findings of this study were consistent with the literature as Earl (2002) noted that teachers with ICT tools were able to increase their communication and interaction with others whether in a school district or outside it, and also that students' knowledge improved relationships when they were working around a computer. Treagust and Rennie (1993) noted that, Teachers with ICT teachers can gain

confidence and competence; seek support from experts in ICT through the Internet networks; and investigate websites about ICT in education. Ryba (1992) identified that “students often appear to learn more from one another than they do from interacting with the computer on its own. It is what people do with the technology that determines its effectiveness in teaching and learning” (p.86).

Lesson planning and preparation

The findings in the literature show that most of the use of ICT tools were for lesson planning and preparation; search the Internet for lesson ideas; produce task sheets or tests using word processors; and to record lessons or unit plans in packages such as 3D Achieve. Ham et al., (2002) noted that different activities in integrating ICT tools can be used. Teachers are drawing on all the knowledge, skills, and ideas to create a dynamic science resource. Most of science teachers around three quarters were using the laptop to prepare student handouts or worksheets and access the Internet (Cowie et al., 2008).

The findings of this study were consistent with the literature as the highest rate of lesson planning and preparation (71 %) was for preparation of student handouts and worksheets, 63 percent for producing lesson materials and 56 percent for the accessing the Internet. One participant (GOVR F-5) specified that they used ICT tools to perform interactive educational projects for Physics and also, they used ICT tools to make searches related to their subject.

In the classroom

Findings in this study found that currently there was a development of the use of ICT tools in the science classroom as the teachers were accessing these tools and trying to integrate them into their subjects to enhance teaching and learning. Using the digital projector was the most common ICT activity across 37 secondary school classrooms for science teachers as this tool was the most commonly tool used for 56 percent of teachers to present their lessons to their students. Teachers also were interested to change the way of teaching by using the available tools in their schools. And that was

not just limited to the use of ICT hardware but also ICT software. More than one third (36 %) were using curriculum-specific software. However, only 2 percent of teachers accessed the Internet during lessons. This was because of the shortage of Internet access in the schools. This is positive evidence that teachers' ability to use ICT will improve, their ways of teaching will change and they will be able to add value to their science subjects. The findings of this study were consistent with the literature as Cowie et al. (2008) noted that teachers used their laptops in the classroom to present their lessons through the PowerPoint presentation even though the use of PowerPoint was not widespread. They added that most of teachers 72 percent were accessed to data projector/digital projector. Science teachers who they used their laptop often in both physics and chemistry classes with applets and the animation programs believed that the use of ICT tools was the way to make obvious practical experiments and illustrate the reaction and explosions as real.

Evaluation and assessment

Research suggests that any task to be successful needs to be evaluated. Earl (2002) noted that evaluated were needed when teaching methods involving ICT used in the classroom. Having feedback and reflection leads to gaining knowledge, skills and the understanding of what has been done in the classroom to enhance learning experiences. Shulman (1997) explains that, in America "The assessment of teachers in most states consists of some combination of basic-skills test, an examination of competence in subject matter, and observation in the classroom to ensure that certain aspects of general teaching behaviour are present" (1987, p.6). Furthermore, teachers can use ICT to motivate their students by creating interactive science tests, giving and getting immediate feedback to and from students after exams and analysing data statistically (Nood, 2007). Participants in this research also believed that when they were using ICT tools the opportunities to evaluate and assess their students become easy, and that was very important to motivate and encourage students to learn. Approximately, 48 percent of the participants used ICT with their students, 53 percent had made progress in creating an interactive science test, and nearly one third of teachers used ICT tools to give/receive immediate feedback to/from students of

exam lessons. Dal and Lefever (2002) identified that the important part of the teaching and learning process was the assessment using ICT. In addition to electronic portfolios and essays written in electronic format, the application of ICT to the evaluation and assessment process has provided teachers with a wide variety of new opportunities (Dal & Lefever, 2002). They added that teachers can use ICT for interactive feedback, formative assessment, summative assessment, and self-assessment.

Findings in this study showed that most teachers were familiar with accessing specific tools such as ‘digital projector’, ‘printers’, ‘TV monitor VCR/DVD player’ and ‘laptop for teacher use’ as mentioned above. These tools were available in most of schools involved in this study. Other reasons were indicated for using these tools like saving time, enjoyment, student motivation, and the easy way that these tools provided access to information. The science teachers had made use of these tools as over 66 percent of both female and male were using a ‘digital projector’. Female teachers used their laptop for preparing their lessons, presenting the structure of experiments in the laboratory and accessed the Internet more than male teachers (female 62 %; male 38 %).

Teachers in this study used other tools such as the digital microscope and the interactive whiteboard much less as only 16 percent indicated they used these daily. However, this study also indicated that only a few schools have these tools available.

Furthermore, in this study the researcher found that according to teachers’ responses there was no difference between the types of schools access to the ICT equipment. The Aramco Company schools are usually expected to be provided with high quality resources and ongoing maintenance of the building and of the resources as well, but, in this study, the equipment was the same as that of the rented schools and public schools.

Participants in this study showed that their uses of ICT were focused on using two or three tools available for them. And they showed a good integration of these tools into their subjects whether physics, chemistry or biology. Different examples were indicated using specific tools such as digital projector, laptop and digital camera. These examples were distinguished from one subject to another by including the different ways teachers used ICT tools to enrich their lessons. For instance, participants prepared their lessons which included life pictures, video clips by using programs such as Flash and presented that using PowerPoint to enhance lessons. And that was consistent with the literature findings in this study. As Department for Education & Skills (2004) indicated that ICT tools such as digital microscopes, interactive whiteboard, video projection units, CD-ROMs, presentations with video, resources selected from Internet, prepared handout for students and model data will continue to impact education and these will have advantages for the students. The Saudi's High Ministry of Education (2006) noted that their goals are to blend ICT with education and improve the e-learning environment to cope with the new age of technology. ICT will enhance the way of teaching. It will open new opportunities for both science teachers and students to improve their knowledge, experiences, and ability to investigate, explore, observe and undertake experiments effectively.

Implementation of ICT activities

Research suggested that teachers can increase the use of ICT tools and enhance teaching and learning, if they use these tools in different activities like using a digital microscope to conduct experiments in science and check specimens; developing science lessons by designing informative PowerPoint; etc, (Earl, 2002). The findings of this research are consistent with this, as the responses showed that teachers were comfortable using ICT tools with different activities to enhance teaching and learning (see p.78, Implementation of ICT activities). Teachers also appeared to be at ease with using ICT tools to develop science lessons by designing informative PowerPoint, Web pages, Flash animations, and digital video productions, which showed the highest percentage of their responses (73 %). And perhaps they were just

using PowerPoint as they indicated that they need more software topics in a PD programs training. One female teacher noted that:

We need to learn how to plan and prepare our lessons by using software programmes such as Flash and Microsoft Office. (GOVR/R F-17)

Most of the science teachers in this study (68 %) stated that they were using ICT tools at least once or twice a year to perform activities such as creating an interactive science test and quiz to improve their students' perceptions of science subjects. The delivery of instructions to science classes by using ICT tools was another activity that teachers used to enhance teaching and learning as 65 percent of them were active in this area. Denby and Campbell (2005) noted that ICT provided teachers with many opportunities to improve the quality of information available to students. It helps teachers to prepare their lesson planning by using the Internet browsers, multimedia CD-ROMs, developing science lessons and also allows teachers to create interactive learning modules.

The remainder of the activities listed (in question 14, see Appendix 1) which probed frequency of usage involving more recently introduced tools such as 'digital microscope' 31 percent, 'web-quests' 33 percent, 'sensors' 41 percent, 'games show review' 46 percent, 'data-show' 46 percent, and 'create models' 50 percent, indicated that over half of them did not use these activities (Never). The responses of 'Never', are likely to be the result of the total absence of such tools within their schools and not an indication of lack of interest or ability in using them. One female teacher noted that:

We need to be supported with ICT tools as there was a shortage of these tools in our school. (GOVR F-2)

5.2 Professional Development (PD)

Saudi Arabia is just one among the many countries that have provided their schools with ICT tools and wants its teachers to become expert on how to use these tools in their classrooms. Nowadays, major professional development ICT programmes have been initiated in Saudi Arabia (Ministry of Education, 2007). As indicated in Chapter 2, this plan was focused on teacher training programmes and one of these programmes is the draft of Information Technology and Communication in the Teaching of Science and Mathematics in Secondary Schools. Participants in this study believe there is a shortage of professional development. An analysis of the data displayed that the most of the science teachers (85 %) from different subjects and from different types of schools (public, rented and Aramco Company schools) did not take any PD from their schools or from the Ministry of Education. The percentage of the teachers who depended on themselves to learn how these tools work, was around half (male 55 %; female 47 %); while the others (male 29 %; female 20 %) learned from their friends and only a few of them learned from the technical support.

From the results above, which were about the importance of ICT PD, it was clear that the professional development is a very important demand for the Saudi Arabia government and for science teachers to enhance the way of teaching and learning and create new ideas using ICT tools to cope with the new era of technology (see Section 2.3 PD Programme (ICTPD), p.30). However, that depended on the teachers themselves and their belief of the benefits of these tools. There is no doubt that ICT PD is essential to the discovery of new ways of teaching and to bringing about positive changes to the education system, to encouraging new ways of thinking, to implementing new ideas in science classrooms, and to encouraging teachers and students to continue development. Along with that, teachers are considered as a main factor for the educational change being successful. Earl (2002) argued that this is because teachers' efforts, thinking and beliefs about teaching and learning are put into practice when they teach the students in the classroom. Scott (2000) has indicated that "In education, the most crucial leaders for change are the teachers who have the final

say in whether a great idea is actually put into practice in a way that works for students” (p.8).

Impact of the PD on the use of ICT and the success of the PD

For most science teachers in this study who indicated in their responses (12 male; 6 female) they had taken a PD programme, it had a positive impact on their teaching, even though they felt there was a shortage of PD provided for them. The reason that was given by these science teachers for the success that was generated from the PD was that they were able to make a presentation for their lessons. PD was successful as it helped them to deliver the lessons to their students using ICT tools. It opened different pathways for them to improve their teaching and learning using these tools (see Section 4.1 Teachers’ Current Use of ICT Tools, p.73). Participants were aware of the importance of the use of ICT tools with their subjects as most of them thought that the greatest gain would be generated when they used these tools. Benefits for the students would be to improve their capabilities, learning, develop their knowledge and keep abreast of developments in the world. These teachers believe that ICT will change the study routine for both teachers and students. More observation, understanding and investigation opportunities for students will be gained and their motivation will be increased. These students will learn by new ways of teaching using ICT tools. Also it will develop students’ cognition and their belonging to the school and community and a sense of their value and their creation. It will reactive their mind and thinking and increase their love for study.

Those finding are consistent with the literature. In Australia, for example, Dawson et al., (2006) noted that ICT tools considered as an important part to be integrated in all subjects to enhance all teaching and learning. They added that teachers in all the schools in Australian were in the process of provided with computers to encourage and motivate teachers to gain expertise to use them in their teaching. As a result, the uses of ICT will improve, different ways of teaching will be appear, and teachers will be able to add value to their science subjects. Another example is from New Zealand secondary schools, Earl (2002) noted that when ICT tools used with different

activities that might increase students' motivation and improve their attitudes towards the subjects and their interest in learning.

Findings from literature showed that when teachers use ICT tools effectively they will improve their mastery of the tools of ICT and develop their skills. More communication with other teachers in the same field will be increased. More information from their access to the Internet will be gained. New ways of teaching will be discovered. They believed that when they use ICT tools in the right way and when they have a well prepared PD programme they will become fully aware of the importance of ICT tools and also their consciousness will be increased. The literature identifies some needs for the success of PD. Jones et al., (1994) noted that there were various parts needed for professional development to be successful such as acknowledge, incorporate and address teachers' prior ideas, beliefs, experiences, concerns, interests and feelings. For PD to be successful, teachers need to develop appropriate ICT activities in the classroom, positive attitudes to the change process, understand that process as potentially leading to better learning conditions.

Compton and Jones in 1998 explained that for PD to be successful, there needs to be a spotlight on how ICT/technology can become a part of the school, classroom and curriculum. Awareness of the aim of integrated ICT into education was also another needed for PD to be successful. They added that using ICT as a part of the curriculum and as a teaching aid will serve to educate both teachers and students on how these technologies can be used to enhance learning.

Barriers

Of course, nothing can be hundred percent perfect. Participants, however, said that the PD that had been taken was not very successful because the teachers who trained them were not qualified or professional. They added that the Ministry of Education or the organizer for these programmes should provide a team who are expert in training for the use of ICT tools. And they noted in their comments that most of the training programmes were more theoretical than practical, not only that, the ICT tools that

they had training on were not available at their schools. Literature also identifies many boundaries that could break the wheel of ICT training and make it not useful, such things as the poor ability of the tutor to deliver the information for teachers, the pace being too fast or too relaxed for teachers' stage of development, insufficient tools to provide adequate access during the course and too much information or too much jargon (Williams et al., 2002).

The science teachers in this study faced many boundaries in utilising ICT in the science classroom, and that may happen everywhere. Table 4.12 (p.87) summarizes the factors that were seen by teachers as prohibiting their use of ICT. Lack of PD available for them was the main reason given by science secondary teachers both male and female for not using ICT tools (male 32 %; female 30 %). Teachers in this study also noted other prohibiting factors such as other duties/responsibilities, limited time, resourcing and little or no encouragement from school management. Balanskat et al. (2007) identified that there are a variety of boundaries that could limit teachers in using ICT tools, such as the lack of ICT skills. Also, there is unwillingness in many teachers towards use of ICT. Many of them did not want to increase their personal burden for reasons of nearing retiring age and lack of desire to displace conventional methods, as well as a fear of wasting time by using technical means. Of particular significance, they point out the lack of incentives and encouragement from those responsible for the promotion of ICT. One of the most significance barriers indicated by the participants in this research was the lack of a suitable school building which should include a resources room and laboratory fully equipped with high technologies. In particular, Balanskat et al. supported that, as they said a lack of interest and disregard for infrastructure requirements of ICT from decision-makers could be one of the barriers. Also they observed that teachers had various negative attitudes to the change process and a general lack of understanding that the process had the potential to lead to better learning conditions (see Section 4.3 Beliefs about ICT, P.92). Participants in this study also commented there is a shortage of training programmes in some tools that are provided such as, the 'sensors'. The overload of work on teachers' shoulders, especially female teachers, like looking after children,

makes it difficult for them to improve their skills in utilising ICT tools. In Saudi Arabia, for example, Al-Otaibi (2006) noted that female teachers, more than male teachers, show an under-utilisation of ICT tools, as female teachers spend most of their time raising their own children, rather than attending training programmes. Findings in this study found that more male than female teachers attended PD (12 male; 6 female). Furthermore, in this study, participants recognise the boundaries/problems they may face when they use ICT tools in their schools especially with their science classroom. One boundary is that, with the huge number of the students in each class, the teacher could lose control of use of ICT tools in both classroom and laboratory potentially resulting in damage to the ICT. Another problem is lack of access to the Internet.

They added that training needs to be supported by technicians who should be able to provide teachers with any help related to ICT. It is also very important that this group of staff continues to develop their own skills and knowledge.

Teachers need to improve ICT use

Research suggested that to improve ICT use teachers need to be coping with these new technologies, skills and knowledge as they still in the early stage of ICT development. That is the key to effective implementation of ICT in teaching and learning (Williams et al., 2002). They added that teachers need the training which is relevant in terms of content and timing so as to enable them to take advantage of the ICT which is becoming available in schools. They added that technical support team are important to provide teachers with any help related to ICT. It is very important also that this team is continuing to develop their skills and knowledge. The findings of this research are consistent with this as participants believed that more training in ICT was needed to help the process of integrating ICT into classroom practice. The suggestion here was that the support for these teachers to develop the practice of using ICT tools, such as, the funds, science materials, tools and rewards, would solve the shortage of science teachers in some schools (see Section 4.2 Professional Development, p.74). Maintenance and keeping teachers up-to-date with the new

science information would be very helpful. In terms of customs and culture, female teachers need support from their family to attend training programmes outside school or away from their home location as some families did not allow their girls to spend much time outside home, especially after school time, unless there is something urgent. And that does not necessarily happen with all Saudi families. Furthermore, female teachers suggested that more working with other teachers from different districts in the same subjects would result in more development in the practice of the using ICT tools. More practical workshops supported by the Ministry of Education were seen to be needed as well.

5.3 Teachers' Beliefs about ICT

Research suggested that teachers believed that teaching and learning had impacted positively and motivated both teachers and students when they used ICT in a science classroom. Many interactive activities will appear for students to be involved with and their interest and attention span will increase, when teachers use ICT tools in their science subject. ICT had opened different ways in front of teachers to create/use new ways of teaching including a wide range of real materials. Teachers can modify these materials and they are used in different and effective ways (Denby & Campbell, 2005). The findings of this study are consistent with this as participants from different science subjects agreed that the use of ICT tools attracted both teachers and students. Around one third (strongly agree 30 %; agree 39 %) enjoyed teaching their subjects using ICT tools, particularly when they saw their students' positive reactions. The teachers also were motivated to share the science teaching resources that they had developed using ICT with other teachers (strongly agree 30 %; agree 32 %). Teachers believed that students' ability to learn, investigate, explore, observe, do experiments, access digital science resources etc., would improve by using ICT (strongly agree 29 %; agree 32 %). Teaching science using ICT tools available for science subjects was more exciting as many enjoyed using these tools to develop teaching and learning (strongly agree 26 %; agree 34 %). The chance of an innovation being implemented increases with the level of personal commitment to making that change by the individual involved. As this study showed, teachers were able to change the way they

teach. Furthermore, some were able to change the way that they related to the students, (strongly agree 21 %; agree 30 %).

However, the use of ICT does not always benefit everyone. Participants in this study believed that students may learn more about the ICT tools than the science subject content while the aim was to improve teaching and learning depending on the use of ICT tools. Other teachers felt that there was just too much change coming too fast for them and they could not fit in with that change. This is consistent with the literature as Balanskat et al. (2007) noted that the usage of ICT as a learning tool had been increased faster, and teachers are now being challenged by how to avoid reinventing strategies for ICT use.

Furthermore, findings of this study indicated that participants believed that the use of ICT tools, especially the laptop for personal use, might be the most valuable tool for them, as around 54 percent of males and 47 percent of females suggested that. This is consistent with the literature review as Cowie et al. (2008) noted that the general attitude of science teachers was positive as the laptop had become a portable office that could be transported easily between school and home. Teachers had become familiar with their laptop, and most preferred to prepare their lessons at school, sharing with and acquiring knowledge from their colleagues.

ICT integration in science education

Research suggested that secondary schools in Australia have been integrated ICTs in all subjects to enhance teaching and learning (Dowson et al., 2006). They added that teachers will provided with computers to improve their skills and expertise to use them in their teaching. Accordingly, teachers will be able to change the way of teaching and they will be able to add value to their science subjects.

The findings of this research were consistent with this as participants believed that the most significant factor influencing their perceptions of the place of the technological area of ICT within science education is that using ICT to improve science teaching is

very important (84 % of respondents); and 76 percent believed that ICT tools are very necessary to their productivity and efficiency in science subjects. A majority (73 %) assumed that ICT tools for encouraging active learning strategies in science were very important. Nowadays students have become familiar with the use of ICT tools, they have learned and improve the ICT skills by themselves and they have brought these skills to science classrooms in order to help their understanding and enjoyment of science (Denby & Campbell, 2005). They added that teaching and learning had impacted positively when ICT used in a science classroom. That is consistent with what participants in this study (72 %) believed about the importance of ICT from their perspective, as it will improve the students' proficiency in science methods.

Participants in this study also believed that ICT is very important for improving students' scores, their learning in the classroom, proficiency in terms of work and collaboration and preparation for future jobs. Denby and Campbell (2005) argued that ICT tools are playing important roles in enhancing teaching and learning. They give opportunities for teachers to create/use new ways of teaching, including a wide range of real materials. Teachers can modify these and use them in different and effective ways.

Additionally, research suggested that the use of ICT can give access to a huge range of resources that are of high quality and connected to scientific learning. There are comprehensive websites such as the Association for Science Education (ASE), Institute of Biology (IOB), Institute of Physics (IOP) and The Royal Society of Chemistry (RSC) which include a wealth of resources including ideas and information (Denby & Campbell, 2005). Through that wealth of resources, teachers and students are able to communicate with each other to increase their knowledge, sharing ideas and attending online conferences with experts without needing to spend a lot of money on travel. In the other words, through those resources, the world comes into your hands.

The findings of this study were consistent with this as participants believed that ICT is very important to satisfying parent and community interests. Not only that, it will help to access expertise online and give access to up-to-date multi-media resources for science subjects as science teachers believed that these are very necessary to enhance teaching and learning.

Finally, in this study teachers do not seem to been aware of their school's policy for the use of ICT in their schools. This study found that 46 percent of science teachers were somewhat aware of their school policy and also around 25 percent were not aware. Due to the lack of the awareness of the importance to integrate ICT in the science classroom and the benefits that might be gained from that use, there was little or no encouragement from their principals. Different reasons that may impact on how teachers behave towards the use of ICT tools are discussed above in the barriers section. Balanskat et al. (2007) identified that there are variety of boundaries which could stop teachers using ICT tools or impact on their beliefs, such as, the lack of ICT skills, also there is a reluctance of many teachers towards ICT, many of them did not want to increase the burden on them, for reasons of old age and lack of incentives and encouragement from those responsible for the promotion of ICT, in particular, a lack of interest and disregard of infrastructure requirements of ICT from decision-makers. Also they observed that teachers had various negative attitudes to the change process, and a general lack of understanding that the process had the potential to lead to better learning conditions.

5.4 Summary

This chapter has focused on the discussion of the results from the investigation of Provincial Saudi Science Secondary School Teachers' Perceptions of the use of ICT tools to support teaching and learning in three sections: Section 5.1 Teachers' current use of ICT noted that most of the science teachers who participated in this study (92 %) have a personal computer, either desktop or laptop, and that was clear evidence of the awareness of the importance of the use of ICT tools in the science classroom. Most of these tools were less accessible or unavailable to science teachers. Although

teachers identified the most common ICT tools that were available at schools as ‘digital projector’, ‘printers’, ‘TV monitor/VCR/DVD player’ and ‘overhead projector’ as over half of the teachers have these devices in their schools. The science teachers in this study indicated which specific ICT tools they used from the tools that were available to them at their schools. The most used for these tools were for the ‘digital projector’, ‘printer’, ‘TV monitor/VCR/DVD player’, ‘overhead projector’ and ‘laptop for teachers’ use’. Also this section has described the high percentage of teachers use of ICT for lesson planning and preparation.

Section 5.2 Professional development in this chapter described there was a shortage of ICTPD for science teachers as around 85 % of them did not undertake any PD from their schools or the Ministry of Education. However, teachers were recognized that PD was very important for them to enhance the use of ICT tools and integrate into their science classes. Therefore, most teachers had learned how to use ICT tools by themselves. Male teachers also learned from family or friends (more so than female teachers). The impact of ICT PD was positive for those few teachers who had undertaken PD programmes. They indicated that PD was successful as it helps them to deliver the lessons to their students using ICT tools. This section further showed that some teachers have faced dilemmas had avoided the use of ICT tools and it is important to note where teachers encountered these dilemmas and limitations, that impacted on their ability to apply these tools in the classroom. These limiting factors divide into five main areas of concern, which follow in declining order of negative impact: the absence of professional organised PD programmes within the school schedule, the imposition of other traditional duties and responsibilities, limitations of time, inadequate preparation and resourcing, and a lack of encouragement and motivation from school management.

Finally, in the section 5.3 Beliefs about ICT, teachers gave their own perspectives of the use of ICT. Teachers in this study from different science subjects agreed that the use of ICT tools attracted both teachers and students. Around one third of them (strongly agree 30 %; agree 39 %) enjoyed teaching their subjects using ICT tools,

particularly when they saw their students' positive reactions. However, this study also showed that teachers do not seem to be aware of their school's policy for the use of ICT in their schools. This study found that 46 percent of science teachers were somewhat aware of their school's policy and around 25 percent were not aware. Due to the lack of the awareness of the importance to integrate ICT in the science classroom and the benefits that might be gained from that use, there was little or no encouragement from their principals. A conclusion of and recommendations from this study will be presented in Chapter 6.

CHAPTER 6

CONCLUSION

6.0 Introduction

The research set out to investigate Saudi science teachers' perception of the use of ICT tools to enhance teaching and learning and undertake a small and groundwork examination of these teachers current use of ICT, that was explored in the previous chapters. This chapter outlines the conclusions of this study; recommendations, limitations and suggestions for further research.

6.1 Conclusion

The main conclusion of this research is that providing ICT hardware and software resources to a school is not enough to ensure significant developments in use of ICT for teaching and learning in Saudi Science Classrooms. Although most teachers had a personal computer, access to a variety of working ICT continues to be an issue for these teachers. Tools such as 'digital microscope', 'digital camera', 'interactive whiteboard', 'portable computer units', 'laptop for teacher use', 'classroom computer for teacher use', 'student computers in a lab', 'student computers in classroom' and 'scanner' are less accessible or unavailable to science teachers.

Saudi science teachers identified many benefits to teachers and students of using ICT. These benefits could be both for teachers such as the ability of teachers to accessing the Internet, sharing knowledge between teachers in the same subjects, and changing methods of teaching. For students such as improving student learning, changing study methods, improving students' attention, and improving their critical thinking, and greater understanding through observation, analysis and investigation.

Saudi science teachers had made individual efforts to develop their use of ICT for use admin planning and lesson preparation, trial and error, asking friends, read books talk about ICT, using Internet and accessing other schools' examples to become knowledgeable in the use of ICTs and to overcome these problems. Other science

teachers had bought ICT tools such as a laptop and a digital projector by themselves and they practiced using these tools, then they used them daily in science classroom. Teachers also identified barriers. These barriers focused on a lack of appropriate PD and technical support; the absence of professional organised PD programmes within the school schedule; the burden of other traditional duties and responsibilities; limitations of time; inadequate preparation and resourcing; and a lack of encouragement and motivation from school management.

6.2 Recommendations

Recommendations for teachers

Teachers are the key to successful use of ICT. Therefore, teachers should be encouraged to take for granted new roles and responsibilities if ICT is to be effectively applied to enhance teaching and learning quality. More duties are required from science teachers to develop and improve their knowledge, skills and abilities to use ICT in their subjects to enhance teaching and learning, such as, attending training programmes even though it not provided by school or the Ministry of Education. Additionally, being motivated, encouraged and looked forward to the importance of the use of ICT. Teachers also need to be proactive and benefit both from other teachers in the same field and students' experiences on this field as most students nowadays are familiar with how to use these tools.

Recommendations for PD

Professional Development (PD) programmes for teachers with a focus on practical classroom uses are needed. These PD programmes need to be funded by the Ministry of Education, and time for the purposes of PD should be guaranteed in employment contracts of teachers. In addition, the content of the PD programme should be the subject of consultations and/or negotiations between teachers, training providers and professional associations to ensure relevance, feasibility and effectiveness.

Recommendations for school managers

Science teachers should have sufficient planning time as part of their work obligations to ensure they are able to introduce ICT into their pedagogical practice which favours high quality and appropriate learning. This planning time required should be decided with due regard to resource implications and organization of schooling, and may be the subject of negotiations between authorities and teachers' organizations.

The school manager should have an awareness of the importance of the use of ICT tools and a full understanding of the policy for the use of ICT in his school. That will help to encourage teachers to integrate these tools into their subjects, motivate teachers to attend ICT PD and develop ways of teaching by using these tools. In addition, the school manager should be up-to-date with the ongoing growth of the technology to enrich his knowledge about ICT and he should attend training programmes to improve his skills in the use of ICT tools. The school manager also should follow the technical support to ensure that equipment is set up and working and be connecting with the Ministry of Education if there is help needed. Feedback from teachers on the time that has been spent on the use of ICT tools in science classes and how effectively that was, will give the school manager a wide view of all teachers who implement these tools into their classes, and enable him to reorganize the school time table and also if there are any problems he can sort them.

Recommendations for the Ministry of Education

The Ministry of Education should provide schools with clear policy on ICT and high quality infrastructure including advice and support. An ICT implementation plan should be promoted as part of a school's development plans. More ICT tools are needed to be provided to schools such as a laptop for all teachers to encourage them to use ICT tools with it, interactive whiteboard, and digital microscope, with extensive practical training on how to use these tools. The Ministry should support schools with up-to-date information relative to ICT tools.

The professional development programmes need to be organized, funded and supported with a professional team in ICT field that is able to deliver the content of the training programme to teachers. Yet, the Ministry of Education should have a plan to train all teachers, providing adequate time for them, especially for female teachers, and it will be good if it were in the school time. Furthermore, teachers with the support of the Ministry of Education could benefit from other teachers in their schools or in other schools (for example, a training programme from identified teachers who are themselves expert). They should be concentrating on the workshops, as they need to provide ongoing workshop training (even if it two days or one day) on available equipment. The content of science subjects needs to be re-organized to fit with the use of ICT tools whether it in the classroom or in the laboratory.

The most important aspect is that rewards/prizes should be given for teachers who attend PD programmes to encourage them and motivate them to implement what they had learned.

6.3 Limitations of this study

The questionnaires have drawn forty five responses out of hundred of the girls' schools and eighty six responses out of hundred of the boys' school of the entire sample, with a total of one hundred thirty one responses out of two hundred. A larger number of participants may have provided a wider range of information for this research. Sending out 200 questionnaires with 65 % response rate was considered satisfactory for a research study at this level.

This research has conducted in the Eastern City of Saudi Arabia in 2007/2008. The participants were selected from different districts of Aldammam, Alkhobar, Aldahran, Alqateaf and Sufwa. The impact of distance was limited in effect on the research as the researcher had reliance on the administrators of the questionnaires to cover these areas and they were been ready to overcome any problem that may could face them while they distributed the questionnaire upon schools.

Different schools were involved in this research: Aramco Company's schools (4 schools with 6 female and 9 male science teachers); public schools (32 schools with 35 female and 73 male science teachers); and small schools in rented premises (4 schools with 4 female and 4 male science teachers). The private schools were not included in this study.

The difficulties that researcher faced were the cultural and religious factors. For example, when the ethics proposal for this research was considered by the ethics committee in the Centre for Science and Technology Education Research, the suggestion was made that electronic questionnaires might be an appropriate method to gather data, and save time. This suggestion was considered, but electronic questionnaires were not used for the following reasons:

- In Muslim countries, especially Saudi Arabia, it is difficult to have communication with females unless they have a relative with them. It is a religious matter; and
- Amongst female participants in Saudi Arabia, there is an inherent resistance to responding to emails from other than personal sources.

The questionnaire design was envisaged that would provide a rich picture of the respondents' feelings and perceptions.

6.4 Suggestions for further research

This research was conducted to investigate the Saudi science teachers' perception of the use of ICT tools to enhance teaching and learning and undertake a small and groundwork examination of these teachers' current use of ICT. It is expected that the results of the research will guide future research and development in the country and outline the importance of the use of information and communication technology in education for teachers, students, parents and decision-makers. It will contribute information towards decision-making and planning in future projects.

REFERENCES

- Al-Otaibi, N. (2006). E-learning impediments in the Kingdom of Saudi Arabia. Mutah University. Retrieved: 17/01/2006 from <http://www.alriyadh.com/2006/12/18/article210141.html>
- American Educational Research Association (1992). What is the graduate school's ethical framework for research? Retrieved December 12, 2007, from www.bristol.ac.uk/education/programmes/doctoral/edd/current/what_is.doc
- Balcon, P. (2003). *ICT in Education System in Europe*. Retrieved on March 17, 2008 from http://www.elearningeuropa.info/directory/index.php?doc_id=949&doclng=6&page=doc
- Balanskat, A., Blamire, R. & Kefalla, S. (2007). *The ICT impact report*. Retrieved on November 17, 2007 from http://insight.eun.org/ww/en/pub/insight/misc/specialreports/impact_study.htm
- Becta, (2006). School improvement through ICT: A guide for secondary school teachers. Retrieved June 17, 2008, from <http://www.becta.org.uk/publications>
- Becta, (2008). Next Generation Learning is a Becta-led campaign to help everyone in the UK benefit from the effective and innovative use of technology throughout learning. Retrieved June 17, 2008, from <http://www.nextgenerationlearning.org.uk/>
- Bell, M. A. (2002). Why use an interactive whiteboard. Retrieved on November 16, 2007 from <http://teachers.net/gazett/jan02/mabell.html>
- Bell, B. and Gilbert, J. (1994) Teacher Development as professional, personal and Social development. *Teaching and Teacher Education*. 10, 483-497. ISSN 0742-051X
- Burgess, F. T. (2001). Guide to the design of questionnaire. University of Leeds. Retrieved January 24, 2007, from <http://www.leeds.ac.uk/iss/documentation/top/top2.pdf>
- Butcher, N. (2003) *Technological Infrastructure and Use of ICT in Education in Africa: an Overview*, Paris: ADEA (copy in Reading Room; also available at http://www.adeanet.org/wgdeol/wgdeol/publications/En_DEOL_Publications.htm)
- Criscito, P. (2003). Barron's guide to distance learning: Degrees, certificates, courses. Retrieved on February 26, 2007 from http://www.webopedia.com/TERM/D/distance_learning.html

- Cohen, L., & Manion, L., (1994). *Research methods in education* (4th ed.). London & New York: Routledge.
- Cohen, L., Manion, L., & Morrison, K. (2005). *Research methods in education* (5th ed.). London: Routledge.
- Compton, V., & Jones, A. (1998). Reflecting on teacher development in technology education: Implementation for future programmes. *International Journal Technology and Design Education*, 8(2), 151-166. ISSN 0957-7572
- Cowie, B., Jones, A., Harlow, A., McGee, C., Millar, Cooper, B., & Gardiner, B. (2008). *Digital horizons: Laptops for teachers' evaluation. Year 9-13 final research Report*. Commissioned by the Ministry of Education. The University of Waikato
- Cox, M., Preston, C., & Cox, K. (1999). What factors support or prevent teachers from using ICT in their classrooms? Paper presented at the *British Educational Research Association Annual Conference*, University of Sussex, Brighton, 2-5 September. Available online at:
<http://www.leeds.ac.uk/educol/documents/00001304.html>
- Dal & Lefever, (2002) How do teachers use information and communication technology in Icelandic high schools. Retrieved March 5, 2008, from
<http://ecet.ecs.ru.acad.bg/cst/Docs/proceedings/S4/IV-4.pdf>
- Dawson, V., Forster, P., & Reid, D. (2006). Information communication technology (ICT) integration. In *Science education unit for preservice science teachers: Students' perceptions of their ICT skills, knowledge and pedagogy*. *International Journal of Science and Mathematics Education* (2006) 4: 345-363. National Science Council, Taiwan 2005.
- David, O. (1997). Questionnaire Design. Georgia Technology College of Computing. Retrieved February 5, 2007, from
http://www.cc.gatech.edu/classes/cs6751_97_winter/Topics/quest-design/
- Davidson, J. (1970). *Outdoor recreation surveys: The design and use of questionnaires for site surveys*. London: Countryside Commission.
- Delamont, Sara (1992). Beauty lives though lilies die: Analysing and theorizing. *Fieldwork in educational settings: Methods, pitfalls and perspectives* (pp. 149-162). London: Falmer. ISBN: 1850009570.
- Denby, D., & Campbell, B. (2005). *ICT in support of science education: A practical user's guide*. (5th edition). Retrieved on November 18, 2007 from
<http://www.leggott.ac.uk/pdfs/awards/ICTinsupport.pdf>

- Denzin, N. K., & Lincoln, Y. S. (Eds.), (1998). *Handbook of qualitative research*. Thousand Oaks, CA: Sage Publications.
- Department for Education & Skills. (2004). Key stage 3: National Strategy. ICT across the curriculum and ICT in science. Retrieved on November 18, 2007 from
<http://ngfl.northumberland.gov.uk/secondaryict/documents/ICTAC/science.pdf>
- Donmoyer, R. (2006). Take my paradigm please! The legacy of Kuhn's construct in educational research. *QSE 19*, (1), 11-34
- Downes, S. (1998). The Future of Online Learning. Assiniboine Community College.
- Dykes, R. (2002). Information literacy – A separate skill or a new approach to learning? *Computers in NZ schools*, 14(2), 26-30. ISSN 0114 4081
- Earl, K. (2002). *Curriculum innovation in a New Zealand Secondary School: Identification of enablers and inhibitors*. Unpublished masters thesis.
- Education Gazette, (2002). Experimental video. Retrieved on November 18, 2007 from
<http://edgazette.govt.nz/articles.php?action=view&id=6170>
- Fowler, F. (1998). Design and evaluation of survey questions. In L. Bickman & D. Rog (Eds.) *Handbook of applied social research methods* (pp. 365-374). Thousand Oaks, CA: Sage.
- Guba, E. C., & Lincoln, Y. S. (1994). Competing paradigms in qualitative research. In N.K. Denzin & Y. S. Lincoln (Eds.). *Handbook of qualitative research*. Thousand Oaks: Sage Publications.
- Gorard, S. (2001). *Quantitative methods in educational research*. London: Continuum.
- Haddad, W. D., & Draxler, A. (2002). *Technologies for education*. Paris: UNESCO and the Academy for Educational Development.
- Ham, V., Gilmore, A., Kachelhoffer, A., Morrow, D., Moeau, P., & Wenmouth, D. (2002). *What makes for effective teacher professional development in ICT? An evaluation of the 23 ICTPD School Clusters Programme 1999-2001*, Wellington, New Zealand: Ministry of Education.
- Hamza, M., & Alhalabi, B. (1990). Technology and education: Between chaos and order. Retrieved on November 18, 2007 from
http://www.firstmonday.org/issues/issue4_3/hamza/index.html#author

- Hawkins, R.J. (2002) "Ten Lessons for ICT and Education in the Developing World." In S. Dutta, B. Lanvin, and F. Paua, (Eds.), *Global information technology report 2004- 2005*, World Economic Forum: Oxford University Press.
- Hamdan, W. T. (2005). *Educational research*. University of Damascus. Syria.
Retrieved February 2, 2007, from
http://dentalarab.com/site/index.php?page=show_det&id=181
- Harlen, W. (1993). *Developing public understanding of education a role for educational researchers*. University of Liverpool. From:
<http://www.bera.ac.uk/addressdownloads/Harlen,%201993.pdf>
- Irving, L. (1999). Expanding opportunities for rural communities. Rural Telecommunication Institute Annual Summit. Somerset, Kentucky May 21, 1999.
- Jacobson, M., & Levin, J. (1993). *Conceptual frameworks for network learning environments: Constructing personal and shared knowledge spaces*. Location of publishers: University of Illinois at Urbana-Champaign and Vanderbilt University
- Jonassen, D., Howland, J., Moore, J., & Marra, R. (2003). Building technology-supported learning communities on the Internet. In (editors) *Learning to solve problems with technology: A constructivist perspective*. (pp.70-120). Upper Saddle River, NJ: Merrill Prentice Hall.
- Jones, A., Mather, V., and Carr, M. (1994) Working with teachers to enhance student technological capability, In *Issues in the Practice of Technology Education*, Vol. 3: Working papers from the third phase of the Learning in Technology Education Project. pp 1-43. Centre for Science, Mathematics and Technology Education Research, University of Waikato, Hamilton, New Zealand. ISBN 908851-31-6
- Kukulska-Hulme, A. (2005). Conclusions. In K-H. Agnes & T. John (Eds.), *Mobile learning* (pp. 189-196).New York: Routledge.
- Lau, L. K. (2002). *Distance learning technologies: Issues, trends and opportunities*. Hershey, PA: Idea Group.
- Lather, P. (1992). Critical frames in educational research: feminist and post-structural Perspectives. *Theory into Practice* 31(2): 87-99
- Layton, D. (1994). A school subject in the making? The search for fundamentals. In D. Layton (Ed.), *Innovation in Science and technology education.4*. Paris: UNESCO Publishing.

- Matthiasdottir, A., Dal, M. and Lefever, S. C. (2002). How do teachers use information and communication technology in Icelandic high schools in 2002? International Conference on Computer Systems and Technologies – *CompSysTech '2003* Retrieved on March 19, 2008 from <http://ecet.ecs.ru.acad.bg/cst/Docs/Proceedings/S4/IV-4.pdf>
- McCarney, J. (2004), Effective models of staff development in ICT. *European Journal of Teacher Education*, 27 (1) 61–72
- McKenzie, J. (1998). Secrets of success: Professional development that works. *eschool News*. Retrieved on March 18, 2008 from <http://www.staffdevelop.org>
- Mikis, M. K. (2004). Challenges in the usage and teaching of ICT in schools. Retrieved on March 12, 2008 from <http://www.oki.hu/oldal.php?tipus=cikk&kod=link-Challenges>
- Ministry of Education, (2003). *ICT in Saudi Arabia*. Retrieved on November 13, 2007 from http://www.itu.int/dms_pub/itu-s/md/03/wsispc3/c/S03-WSISPC3-C-0025!!MSW-A.doc
- Ministry of Education, (2007). *Report of King Abdul Abdullah Bin Abdul Aziz' project for the development of public education*. Riyadh, K.S.A.: The Ministry of Education.
- Molhem, S. M. (2005). *Research methods in education and psychology*. Amman Almasera Press.
- Nood, B. (2007). The E-Learning Environment. Retrieved on March 12, 2008 from <http://www.sciencewithmrnoon.com/tech03.htm>
- Ofsted. (2003). Good Assessment Practice in Information and Communication Technology. Document printed and on website © Crown copyright 2003. Retrieved on March 27, 2008 from www.ofsted.gov.uk/assets/3212.doc
- Osborne, J., & Hennessy, S. (2003). The Role of ICT in Science Education. Futurelab. Retrieved on November 18, 2007 from http://www.futurelab.org.uk/resources/documents/lit_reviews/Secondary_Science_Review.pdf
- Paine, N. (2001). *Brining Science Alive*. The Times Educational Supplement. London: Nov 9, 2001. , lss. 4454; p. O18
- Prahalad & Hart (2002). The Fortune at the Bottom of the Pyramid. Strategy + business issue 26. Booz Allen Hamilton Inc. All rights reserved. Retrieved on November 18, 2007 from <http://www.cs.berkeley.edu/~brewer/ict4b/Fortune-BoP.pdf>

- Robson, C. (2002) *Real World Research*. Oxford: Blackwell.
- Rojas, L., & Serpa, F. (2005). *Questionnaire design: An introduction*. University of Pittsburgh. Retrieved on January 24, 2007, from <http://www.pitt.edu/~super1/lecture/lec0971/>
- Ryba, K. (1992). Creating Effective Computer Learning Environments: People Effects and Social Practices. In Kwork-Wing Lia and Bruce Macmillan (Eds.), *Learning With Computers: Issues and Application in New Zealand*. Chapter 5. Palmerston North: The Dunmore Press.
- Saudi's High Ministry of Education, (2006). *Report of King the First Step of the E-education and Distance Education*. Riyadh, K.S.A.: The Ministry of Higher Education.
- Scott, G. (2000). Good ideas with no ideas on how to implement them are wasted ideas *Distance Education Association of New Zealand 2000 Conference proceedings*. Dunedin, 27-29 April, St Margaret's College, University of Otago.
- Shulman, L. S. (1987) Knowledge and teaching: Foundation of the new reform. *Harvard Education Review*, 57(1), 1-22. ISSN 00178055
- Strauss, A., & Corbin, J. (1998). *Basics of qualitative research: techniques and procedures for developing grounded theory*. Thousand Oaks, California: Sage Publications.
- Tasar, M. F. (2006). Book reviews of ICT fluency and high Schools: A workshop summary. By National Research Council of the National Academies 2006. In *Eurasia Journal of Mathematics, Science & Technology Education*, 2007, 3(1), 93-97 Retrieved on August 10, 2006 from http://www.ejmste.com/v3n1/EJMSTE_v3n1_BRs.pdf
- Tech Target, (2007). Definition of Information Communication Technology. Retrieved on August 10, 2007 from http://searchsmb.techtarget.com/sDefinition/0,,sid44_gci928405,00.html
- Treagust, D. F., & Rennie, L. J. (1993, Fall). Implementing technology in the school curriculum: A case study involving six schools. *Journal of Technology Education*. 5(1), 38-53. ISSN 1045-1064
- Trochim, W., & Donnelly, J. P. (2006). *The research methods knowledge base*, 3e. Atomic Dog Publishing, 2006.
- Williams, D., Coles, L., Wilson, K., Richardson, A., & Tuson, J. (2002). Teachers and ICT: Current use and future needs. Retrieved on November 13, 2007 from <http://www.blackwell-synergy.com/doi/pdf/10.1111/1467-8535.00164>

Worthen, B. R., Borg, W. R., & White, K. R. (1993). Measurement and evaluation in the school. NY: Longman. Retrieved on March 5, 2008, from <http://course1.winona.edu/lgray/el626/MandEtext3.html>

APPENDICES

APENDIX 1

QUESTIONNAIRE

Science Teacher's survey



Study of Saudi Science Secondary
School Teachers' Perceptions
and the Use of ICT Tools to Support
Teaching and Learning
2007/2008

Directions

Your school has been selected to participate in this research. This survey asks questions about your perceptions of the use of ICT tools to support teaching and learning.

This survey comes in four sections. Section 1 is made up of general questions about yourself. Section 2 will focus on your current use of ICT tools. Section 3 will focus on your professional development. Section 4 will focus on your belief about ICT. In this survey I use the term "ICT" to refer to information communication technology tools in education (such as computer lab networks, digital microscopes with sensors, projectors, electronic white boards, desktop/laptop, scanner, overhead projector, digital camera, internet etc.).

Any report on this research will focus on key findings and information about individuals will be not divulged. All efforts to maintain confidentiality will be made including secure storage of the data. Please return your questionnaire direct to the administrator. **Your participation is appreciated.**

CORRECT: ●
IN CORRECT: Ø ☒

Osamah Abdulwahab D. Almaghlouth

Section 1: Your details

1. How many years have you taught at your school?
 1-5 years 5-10 years 10-15 years 15 + years

2. Please mark the appropriate range for your age.
 20-30 31-40 41-50 51-60

3. What subjects do you currently teach? Please mark **all** that apply.
 Physics Chemistry Biology

4. What grade level(s) do you currently teach? Please mark **all** that apply.
 10 11 12

Section 2: Use of ICT tools

5. How would you rate your ability to use ICT tools?

 Beginner Intermediate Expert6. Do you have a personal computer? Yes NoIf (Yes), is it a desktop or a laptop

7. For how long do you have one?

 1-2 years 3-5 years 6-10 years

8. Which of the following ICT tools are available in your school?

Tools	Available	
	Yes	No
Digital microscope	<input type="radio"/>	<input type="radio"/>
Digital Projector	<input type="radio"/>	<input type="radio"/>
Interactive whiteboard	<input type="radio"/>	<input type="radio"/>
TV monitor/VCR/DVD player	<input type="radio"/>	<input type="radio"/>
Scanner	<input type="radio"/>	<input type="radio"/>
Digital Camera	<input type="radio"/>	<input type="radio"/>
Printers	<input type="radio"/>	<input type="radio"/>
Overhead Projector	<input type="radio"/>	<input type="radio"/>
Portable computer units	<input type="radio"/>	<input type="radio"/>
Laptop for teacher use	<input type="radio"/>	<input type="radio"/>
Classroom Computer for teacher use	<input type="radio"/>	<input type="radio"/>
Students computer in a lab	<input type="radio"/>	<input type="radio"/>
Students computer in classroom	<input type="radio"/>	<input type="radio"/>

9. Which of the following tools do you use in your school?

Tools	Yes	No
Digital microscope	<input type="radio"/>	<input type="radio"/>
Digital Projector	<input type="radio"/>	<input type="radio"/>
Interactive whiteboard	<input type="radio"/>	<input type="radio"/>
TV monitor/VCR/DVD player	<input type="radio"/>	<input type="radio"/>
Scanner	<input type="radio"/>	<input type="radio"/>
Digital Camera	<input type="radio"/>	<input type="radio"/>
Printers	<input type="radio"/>	<input type="radio"/>
Overhead Projector	<input type="radio"/>	<input type="radio"/>
Portable computer units	<input type="radio"/>	<input type="radio"/>
Laptop for teacher use	<input type="radio"/>	<input type="radio"/>
Classroom Computer for teacher use	<input type="radio"/>	<input type="radio"/>
Students computer in a lab	<input type="radio"/>	<input type="radio"/>
Students computer in classroom	<input type="radio"/>	<input type="radio"/>

10. How often do you use these tools?

Tools	Daily	3 times a week	Once per week	Less than once per week
Digital microscope	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Digital Projector	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Interactive whiteboard	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
TV monitor/VCR/DVD player	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Scanner	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Digital Camera	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Printers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Overhead Projector	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Portable computer units	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Laptop for teacher use	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Classroom Computer for teacher use	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Students computer in a lab	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Students computer in classroom	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

11. What do you use ICT for?

Please tick **all** applicable

Administration	Communication	Lesson planning and preparation	In the classroom	Evaluation and assessment
<input type="radio"/> writing student reports	<input type="radio"/> contacting colleagues via emails	<input type="radio"/> reviewing resources	<input type="radio"/> using curriculum-specific software	<input type="radio"/> motivating students
<input type="radio"/> recording student science grade	<input type="radio"/> participating in online discussion lists	<input type="radio"/> accessing the Internet	<input type="radio"/> presentations	<input type="radio"/> creating interactive science test/quiz
<input type="radio"/> checking students science lists	<input type="radio"/> collaborative development of units	<input type="radio"/> producing lesson materials	<input type="radio"/> teacher access to Internet during lessons	<input type="radio"/> give/get immediate feedback to/from students of exam
<input type="radio"/> checking school timetable or notices	<input type="radio"/> accessing the Internet for professional reading, subject association news, etc.	<input type="radio"/> preparing students handouts and worksheets	<input type="radio"/> teacher access to projector	<input type="radio"/> analyses data statistically
<input type="radio"/> Other.....	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Please add

12. Why do you use the tools you use?

Tools	NA	Reasons for using the ICT tools
Digital microscope	<input type="radio"/>	
Digital Projector	<input type="radio"/>	
Interactive whiteboard	<input type="radio"/>	
TV monitor/VCR/DVD player	<input type="radio"/>	
Scanner	<input type="radio"/>	
Digital Camera	<input type="radio"/>	
Printers	<input type="radio"/>	
Overhead Projector	<input type="radio"/>	
Portable computer units	<input type="radio"/>	
Laptop for teacher use	<input type="radio"/>	
Classroom Computer for teacher use	<input type="radio"/>	
Students' computer in a lab	<input type="radio"/>	
Students' computer in classroom	<input type="radio"/>	

13. From the list above can you please specify one way you have used a tool in your science teaching.

.....

.....

.....

.....

.....

.....

14. How often have you used ICT tools for the following activities?

Activity	Several times a week	Several times a month	Several times a year	Once or twice a year	Never
Use a computer to deliver instruction to your science class.	<input type="radio"/>				
Using Digital Microscope to conduct experiments in science and check specimen.	<input type="radio"/>				
Using the data show and sensors to display data and virtual science experiments.	<input type="radio"/>				
Using sensors to measure Physical changes (e.g. temperature).	<input type="radio"/>				
Using digital camera to create video clip of some scenes (e.g. from plants and animals environment) to prepare samples, discover the plants/animals' life and to explain science phenomena.	<input type="radio"/>				
Using ICT tools to prepare your students to observe, hypotheses, experimental, theorizing and publishing results.	<input type="radio"/>				
Making dissection of animals (e.g. Rat) to show its internal organs using ICT tools.	<input type="radio"/>				
Create models Resembling the original, using ICT tools and encourage and motivate students to do so.	<input type="radio"/>				
Developing science lessons by designing informative power point, web pages, flash animations, and digital video productions.	<input type="radio"/>				
Creating/using science animated cartoon presentations that demonstrate real world interaction by using specific programs.	<input type="radio"/>				
Create web-quests (e.g. live web conferences) providing lessons relevant to science subjects for all guests, or build the internet into a lesson.	<input type="radio"/>				
Data handling (using spreadsheets and graphing software to analyse data).	<input type="radio"/>				
Using games show review; for encouraging students to recall information in a competitive environment.	<input type="radio"/>				
Perform research and lesson planning using the internet browsers, multimedia CD ROMs.	<input type="radio"/>				
Create an interactive science test, quiz and other assignment by using interactive learning modules to improve students' conceptions in their science subjects.	<input type="radio"/>				
Simulation (virtual experiments and visual aids, simulating and helping to explain phenomena).	<input type="radio"/>				

Section 3: Professional Development (PD)

15. How did you know how to use ICT tools?

- Self friend or family help technical support at school
 Commercial help desk/support professional development

16. Have you undergone any PD in ICT?

- Yes (go to question 17) No (go to question 20)

17. Which topics did your PD cover?

18. Who delivered the PD?

- External training provider e-learning/online training in-house training
 University/academic institution other (please specify)

19. Was the PD successful for you?

If (Yes), Why was it successful?

If (No), Why was it not successful?

20. Which of the following barriers have you encountered?

- Little or no encouragement from school management lack of PD
 Limited time other duties/responsibilities resourcing other

Explain further:

21. Have you overcome these barriers to any degree yourself?

- Yes No (go to the question 24)

22. If (Yes), What did you do?

23. How successful was this for you?

24. What topics would you want to learn in a PD?

25. What do you think is the greatest problem facing the school in term of using ICT to enhance teaching and learning?
For the students?

For the teachers?

26. What do you think will be the greatest gain for the school if it uses ICT tools effectively?
For the students?

For the teachers?

Section 4: Beliefs of ICT

27. Please indicate to what extent you agree or disagree with each of the following statements

Question	Strongly agree	Agree	Not sure	Disagree	Strongly disagree
I have made progress during the past year in learning new ICT software.	<input type="radio"/>				
I have made progress during the past year in introducing new ICT into my science classroom.	<input type="radio"/>				
Most of the ICT that has been shown to me would do little to improve my student's ability to learn, investigate, explore, observe/watch, do experiment, represent, access to digital science resources and etc.	<input type="radio"/>				
I have integrated ICT use to such an extent that I am not sure what I would do now if the ICT and programmes were suddenly unavailable for my science classroom.	<input type="radio"/>				
The new ICT we have available in school has caused me to change the way I teach.	<input type="radio"/>				
The new ICT has caused me to change the way I relate to the students.	<input type="radio"/>				
My biggest fear of using these new technologies is embarrassment in front of my students.	<input type="radio"/>				
My biggest fear of using these new technologies is embarrassment in front of my colleagues.	<input type="radio"/>				
My biggest fear of using these new technologies is losing control of the class.	<input type="radio"/>				
The school cannot expect us to learn all this new ICT software unless they give us more time.	<input type="radio"/>				
School cannot expect us to learn all this new ICT software unless they give us extra pay.	<input type="radio"/>				
The best way to learn new things is to take part in a training course.	<input type="radio"/>				
Sometimes I feel that there is just too much change coming too fast.	<input type="radio"/>				
I have begun to enjoy teaching more than ever because of the new ICT capabilities available for science teachers.	<input type="radio"/>				
I am ready to share the science teaching resources I have developed using ICT with other teachers.	<input type="radio"/>				
There is very little evidence to support the benefit for student learning of the integration of ICT in the science classroom.	<input type="radio"/>				
I sometimes feel I have been left behind when it comes to ICT.	<input type="radio"/>				
I have begun to enjoy teaching science subjects using ICT more when I see the students' positive reactions.	<input type="radio"/>				

Question	Strongly agree	Agree	Not sure	Disagree	Strongly disagree
I have put a lot of extra time and effort into keeping up with ICT developments in our school particularly with science tools.	<input type="radio"/>				
I feel frustrated when I see the potential of ICT but not the time to spend working with it.	<input type="radio"/>				
I think that students using ICT learn more about the tool than the science subject content.	<input type="radio"/>				

28. What would you need to help you develop your practice of using ICT to support teaching and learning in science?

feature	Specify your needs
training	
support	
resourcing	
ongoing classroom support	
working with other teachers/buddies	
help with planning	
Practical workshops	
workshops with science case studies	
workshops with useful resources	
One day workshops	
workshops with ongoing follow-up	

29. Which one of the following ICT tools would be most valuable to you?
- | | |
|---|--|
| <input type="radio"/> Laptop for personal use | <input type="radio"/> A desktop computer in your classroom |
| <input type="radio"/> one desktop for each student in a lab | <input type="radio"/> A mobile cart with one wireless laptop |

30. For you personally, how important are each of the following?

Element	very important	somewhat important	slightly important	not important
Using ICT to improve science teaching.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Improving teacher productivity and efficiency in science using ICT tools.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Increasing teacher proficiency in use of ICT in science.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Promoting active learning strategies in science.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Improving students' test scores in science subjects.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Improving students' proficiency in science methods.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Students' proficiency in data analysis.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Using ICT to improve student learning in science classroom.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Students' proficiency in team work and collaboration.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Increase student/computer ratio.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Satisfying parents' and community interests.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Improving students' computer skills and abilities.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Access to expertise online	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Access to up to date multi media resources.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Preparing students for future jobs.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

31. How aware are you of your school policy for the use of ICT in their school?

- | | | | |
|---------------------------------|--------------------------------------|-----------------------------|----------------------------------|
| <input type="radio"/> not aware | <input type="radio"/> somewhat aware | <input type="radio"/> aware | <input type="radio"/> very aware |
|---------------------------------|--------------------------------------|-----------------------------|----------------------------------|

Thank you for completing this questionnaire

APPENDIX 2

REQUEST FOR AUTHORITY

From: General Directorate of Education – Eastern province “Girls”,

Center for Science and Technology,
Education Research,
School of Education,
University of Waikato,
P/Bag 3105,
Hamilton 3240,
New Zealand.

November, 2007

The General Manager of Education,
General directorate of Education – Eastern province “Girls”,

Dear Dr. Samear S. Al-Omran,

**AUTHORIZATION LETTER: SAUDI SCENICE SECONDARY SCHOOL
TEACHERS' PERCIPIONS OF THE USE OF ICT TOOLS TO SUPPORT TEACHING
AND LEARNING**

I am writing you as I would like to inform you that I am asking your authorization for my research to be conducted and to enable the Principals of the selected schools, and the Secretary of Inspectors Department in Al-Khobar City, Mrs. Khloud Abdullah Almaghlouth, to allow the administration of the questionnaire on “Saudi Science Secondary School Teachers’ Perceptions of the Use of ICT Tools to Support Teaching and Learning”.

The information that will be gathered will be used to write a research thesis for my Master Degree in Information Communication Technology (ICT) in Education from the University of Waikato, New Zealand. Your Authorization is requirement of the

University of Waikato Human Research Ethics Regulations 2002 and the ethical guideline of the New Zealand Association for Research in Education (NZARE).

I am involved in finding out about Saudi Science Secondary School Teachers views of ICT. I am seeking these views through the use of a written questionnaire. This study will involve two hundred Saudi science secondary schools teachers from both girls and boys schools. The participants will be from different groups of schools: Aramco company's schools, public schools, and small schools in rented premises. Private schools are not part of this study.

It is expected that the results of the research will guide future research and development in the country and outline the importance of the use of Information and Communication Technology (ICT) in Education for teachers, students, parents and decision-makers. It will contribute information towards decision-making and planning in future projects by King Abdul Abdullah Bin Abdul Aziz for the development of public education. The Questionnaire will be administered in November 2007.

Confidentiality will be respected and maintained at all times. Participants will be requested not to endorse their signatures or any of their identities on the questionnaires. Data will be stored securely and destroyed three years from the completion of the study. Participants will be informed about the work on completion through a summary of the findings which will be sent to each participant's school libraries. Furthermore, participants who will be involved in this study have the right to decline to participate and they retain the ongoing right to withdraw from the project, up until the point that data has been analysed.

Your attention would be appreciated

Your sincerely,

Osamah Abdulwahab Almaghlouth

CC: Dr Judy Moreland, CSTER Kerry Earl, SoE – Supervisors

Principals – The Saudi Secondary Schools

The Secretary of Inspectors Department in Al-Khobar City

APPENDIX 3

REQUEST FOR AUTHORITY

From: General Directorate of Education – Eastern province “Boys”,

Center for Science and Technology,
Education Research,
School of Education,
University of Waikato,
P/Bag 3105,
Hamilton 3240,
New Zealand.

November, 2007

The General Manager of Education,
General directorate of Education – Eastern province “Boys”,
P.O.Box: 35390 Al Dammam 31488

Dear Dr. Abdulrahman I. Al-Mudaires,

AUTHORIZATION LETTER: SAUDI SCENICE SECONDARY SCHOOL
TEACHERS' PERCIPIONS OF THE USE OF ICT TOOLS TO SUPPORT TEACHING
AND LEARNING

I am writing you as I would like to inform you that I am asking your authorization for my research to be conducted and to enable the Principals of the selected schools, and the Assistant Director of the Education Technologies Management in Al-Dammam City, Mr. Moammar bin Gersan Alzahrani, to allow the administration of the questionnaire on “Saudi Science Secondary School Teachers’ Perceptions of the Use of ICT Tools to Support Teaching and Learning”.

The information that will be gathered will be used to write a research thesis for my Master Degree in Information Communication Technology (ICT) in Education from the University of Waikato, New Zealand. Your Authorization is requirement of the

University of Waikato Human Research Ethics Regulations 2002 and the ethical guideline of the New Zealand Association for Research in Education (NZARE).

I am involved in finding out about Saudi Science Secondary School Teachers views of ICT. I am seeking these views through the use of a written questionnaire. This study will involve two hundred Saudi science secondary schools teachers from both girls and boys schools. The participants will be from different groups of schools: Aramco company's schools, public schools, and small schools in rented premises. Private schools are not part of this study.

It is expected that the results of the research will guide future research and development in the country and outline the importance of the use of Information and Communication Technology (ICT) in Education for teachers, students, parents and decision-makers. It will contribute information towards decision-making and planning in future projects by King Abdul Abdullah Bin Abdul Aziz for the development of public education. The Questionnaire will be administered in November 2007.

Confidentiality will be respected and maintained at all times. Participants will be requested not to endorse their signatures or any of their identities on the questionnaires. Data will be stored securely and destroyed three years from the completion of the study. Participants will be informed about the work on completion through a summary of the findings which will be sent to each participant's school libraries. Furthermore, participants who will be involved in this study have the right to decline to participate and they retain the ongoing right to withdraw from the project, up until the point that data has been analysed.

Your attention would be appreciated

Your sincerely,

Osamah Abdulwahab Almaghlouth

CC: Dr Judy Moreland, CSTER Kerry Earl, SoE – Supervisors

Principals – The Saudi Secondary Schools

The Assistant Director of the Education Technologies Management in Al-Dammam
City

APPENDIX 4

INVITATION LETTER

TO: All Participants

Date: / / 2007

From: Osamah Abdulwahab Almaghlouth, Centre for Science and Technology Education Research at University of Waikato.

Title: Questionnaire on “Saudi Science Secondary School Teachers’ Perceptions of the Use of ICT Tools to Support Teaching and Learning”.

I am a master’s student for centre for Science and Technology Education Research at University of Waikato. I am involved in finding out about Saudi Science Secondary School Teachers views of ICT. I am seeking these views through the use of a written questionnaire. This study will involve two hundred Saudi science secondary schools teachers from both girls and boys schools. The participants will be from different groups of schools: Aramco company’s schools, public schools, and small schools in rented premises. Private schools are not part of this study.

The study is being undertaken in performance of the obligation for the honor of a Master of ICT in Education which I am pursuing at The University of Waikato in New Zealand at the Centre for Science and Technology Education Research. Accordingly, I would like to respectfully request you to participate by completing the attached questionnaire to find out your perceptions of the Use of ICT Tools to Support Teaching and Learning in secondary schools.

You are asked to complete the questionnaire, but you are not constrained to do so and you may withdraw from completing it at any stage. Your response will be anonymous, as you are not required to identify yourself on the questionnaire except for your declaration on the consent form. I also wish to assure you that data collected from this questionnaire will not be used for anything else other than my masters’ degree and presentations that arise from it. No one will be allowed access except me and my supervisors, Dr. Judy Moreland of the Centre for Science and Technology

Education Research and Kerry Earl of the school of Education at the University of Waikato. All data will be securely stored and destroyed three years from the completion of the study. Guarantee of confidentiality is given and your completing the questionnaire will not impact on your career in any way.

Should you have any queries, please contact me through email oada1@waikato.ac.nz, or call me on my mobile phone (0064) 212078795 or contact Dr. Judy Moreland on j.moreland@waikato.ac.nz or call on (0064) 7 838 4639, Fax (0064) 7 838 4272 or Kerry Earl on kearl@waikato.ac.nz or call on (0064) 7 838 4506. On the occasion of any questions please contact me in the first instance. If I am unable to resolve them, you may contact Dr. Judy Moreland at j.moreland@waikato.ac.nz or Kerry Earl at kearl@waikato.ac.nz. If the issues are still unresolved you may contact the director of the Centre of Science and Technology Education Research, Dr. Bronwen Cowie at b.cowie@waikato.ac.nz.

Finally, I would like to thank you all for accepting my invitation to complete the questionnaire. Please complete the consent form on the next page. When you have completed the questionnaire, I would appreciate it if you could put it in the envelope provided, seal it, and it will be collected. This is to ensure that no unconstitutional person can see your responses on the questionnaire. If you do not wish to participate, please feel free not to complete the questionnaire.

Thanking you in advance
Osamah Abdulwahab Almaghlouth

APPENDIX 5

Teacher's Consent Form for Questionnaire

I gladly consent to participate in this questionnaire on the understanding that:

- * I have not been pressurized by anyone;
- * The information will be stored securely;
- * I will not be identified in any way. I will be given a code name;
- * Guarantees of confidentiality have been given;
- * The information I give will not impact on my career;
- * My data will be destroyed three years after the completion of the study.

Name:

Signature:

Date:

NOTE: Please attach one of these forms to the questionnaire brochure, which will be collected by the Administrator, along with your completed questionnaire. The other copy is for your information.

APPENDIX 6

Withdrawal Form

If you wish to withdraw in the course of completing the questionnaire, please feel free to do so and sign below.

I wish to withdraw from participating in this questionnaire. I understand that my data will not be used for the study and it will be immediately destroyed.

Name:

Signature:

Date:

APPENDIX 7

Administrator's Consent Form for Questionnaire

I gladly consent to Administrate the questionnaire on the understanding that:

- * I have to distribute all the questionnaires to the participants;
- * Questionnaires will be secured in sealed envelopes, after completion;
- * I am not able to read the questionnaires for any reason;
- * Questionnaires will be collected, coded and passed to translator.

Name:

Signature:

Date:

APPENDIX 8

HELP SHEET

The following are including the guidelines for administering the questionnaire.

1. Completion the questionnaire, should not take more than one hour. And the participants should therefore be advised not rush.
2. Distribute the invitation letter for participants to read it and attend to any questions that the participants may face.
3. Advise any who wish to withdraw now to please do so.
4. Distribute the questionnaire booklet with a consent form attached and the envelopes for putting the questionnaire in.
5. Advise participants to read the consent form and sign it if they wish to participate before opening the questionnaire booklet.
6. Advise those not wishing to participate that they may withdraw any time.
7. Advice those willing to complete the questionnaire that they may withdraw at any stage and they are free to sign withdraw form.
8. Advise the participants how to complete the questionnaire and you may read out the instruction for each section.
9. At the end please correct all envelops containing the completed questionnaire, used and unused, put them in the large envelop enclosed and seal it before leaving the school.

Thanking you in advance

The researcher,

Osamah Abdulwahab Almaghlouth

APPENDIX 9

INSTRUCTIONS FOR PARTICIPANTS

1. Complete the questionnaire unanimously for example; do not sign on any of the pages of the questionnaire.
2. Read the instructions for each section.
3. At the end please seal your questionnaire in the envelope provided and sign on the seal. This is to ensure that no one else reads your responses except the researcher and my supervisors.
4. if you have any questions please ask the administrator or else send me an email to oada1@waikato.ac.nz or email my supervisors at j.moreland@waikato.ac.nz or at kearl@waikato.ac.nz.
5. Thank you all for accepting my invitation to complete the questionnaire. A summary of the findings will be sending to each participant's school libraries before the end of 2008 and you will be encouraged to read it.

Thanking you in advance

The researcher,
Osamah Abdulwahab Almaghlouth