THE UNIVERSITY OF HULL

# *INTRODUCING COMPUTERS INTO SECONDARY SCHOOL SCIENCE TEACHING IN SAUDI ARABIA: TEACHERS' VIEWS, SOME PROBLEMS AND POSSIBLE SOLUTIONS*

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## Frequent Abbreviations

| | |
|---|---|
| CAL | Computer Assisted Learning |
| CBL | Computer Based Learning |
| CESE | Computer to Enhance Science Education Course |
| CSTQ | Computer Studies Teachers Questionnaire |
| DSS | Developmental Secondary School |
| INSET | In Service Training |
| IT | Information Technology |
| MCW | Microworlds Course |
| NCET | National Council for Educational Technology |
| NDPCAL | National Development Programme for CAL |
| NEA | National Education Association |
| NSB | National Science Board |
| NSF | National Science Foundation |
| SA | Kingdom of Saudi Arabia |
| STQ | Science Teachers Questionnaire |
| STTQ | Science Teacher Trainers Questionnaire |
| NFER | National Foundation for Educational Research in England and Wales |

## Abstract

The main aims of the study were to investigate the possibility of introducing computers for science teaching into Saudi Arabian secondary education, to identify problems which might attend their introduction, and to suggest possible solutions.

A preliminary study was carried out in March and April 1991. Interview schedules were used to interview 17 science teachers, 7 computer studies teachers and 3 trainers. The findings of this study were used to confirm the structure and scope of the main study.

The main study was carried out between January and April 1992. 266 science teachers (ST), 15 science advisors (STA), 16 science teacher trainers (STT), and 38 computer studies teachers (CST) were included in the study.

Each of the four samples showed strongly favourable attitudes toward the introduction of computers into the science classroom. On the other hand lack of awareness about using computers to aid science teaching was detected among the three science samples.

The findings of STs showed that the ownership of a personal computer (PC) is the strongest related variable to attitudes toward the introduction of computers into science teaching. Other variables significantly related to most of the scales and factors, included Length of experience, and computer knowledge. Few science teachers' activities show significant relationships with their attitudes generally.

The findings of STTs showed that the ownership of PC and knowledge about wordprocessors in teaching were significantly related to attitudes. Little relationship between computer knowledge and attitudes was found.

No significant relationships were found between any variable and attitudes for both STAs and CSTs samples.

The final two chapters conclude with some problems facing the introduction of computers into Saudi Arabian secondary school science teaching, with suggestions for proposed course-design for science teachers, science teacher trainees and science trainers. Some other features related to teachers' computer training are also covered.

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# CHAPTER 1 : :
# INTRODUCTION TO THE STUDY

## 1.1 Introduction:

This study describes an investigation into the possibility of introducing computers for science teaching into Saudi Arabian secondary education, identifying problems which might attend their introduction, and suggesting possible solutions.

The Kingdom of Saudi Arabia (SA) is a developing country which has attached great importance to the use of computers in education. The introduction of computers to assist teaching is however, a radical step which needs careful policy-making with reference to the costs of introduction, choice of appropriate hardware and software, teacher training, etc. (Mindura, 1991)

The 1985 Developmental Secondary School (DSS) project was accompanied by the introduction of microcomputers and computer courses into Saudi Arabian secondary education. At that time the Minister of Education, Abdulaziz Alkhuwaiter, said, "Expanding the use of computers in our schools is one of the most important tools for transferring technology to our country. We should prepare our society to keep up with advanced technology. I am sure that computers will help our people to achieve this important target." (Alkhuwaiter, 1984)

The current Secondary Schools Project SSP (1992) which has replaced the DSS, has retained and expanded the computer courses. The introduction of twice-weekly computer classes at all secondary school levels reflects the continued interest on the part of the Ministry of Education in enhancing computer knowledge among pupils. More than 8000 computers have been installed in secondary schools throughout the Kingdom during the session 1992-1993 (Al Riyadh, 1992a).

In 1990 the Fifth Development Plan (FDP) 1990-1995 for the Kingdom of Saudi Arabia confirmed the importance of computers in education for all educational levels. The plan stated that "to improve the quality of educational instruction, computer education will be introduced as an integral part of the curriculum at the intermediate level, and as an awareness programme at the elementary level." (FDP, 1990-1995, p. 266)

The FDP also stressed the importance of changes in teaching methods to utilize modern teaching aids for developing the pupils' skills. It stated that, "Notwithstanding the changes introduced into the general education curriculum by the Educational Development Centre, it is imperative to adopt modern teaching methods which emphasize understanding, derivation and problem solving ... Improvements will be introduced into the curriculum and in teaching methods which encourage the development of problem-solving skills and creativity." (FDP, p260 &, p. 266)

Many studies[1] have shown the power of computers for developing pupils' skills and achieving a variety of educational objectives such as: developing problem-solving, thinking and information skills, and improving pupils' attitudes toward science. For example, Cachapuz, et al. (1991) pointed out that "The crisis in schools and teaching, ... is complicated and widespread, but one step towards a solution may be the rapid introduction of personal computers into schools. ... this will give the students new skills, skills that are necessary in international competition for markets and jobs. It will also make the teaching more interesting and creative." (p. 417)

## 1.2 The Problem:

The SA government has given computer education a great deal of support and priority. In recent years they have spent a large amount of money on computer machines and equipment for secondary school education. "Computers have been given continued and unlimited support by the government," said Alzaid, the director of the Western Province General Educational Authority, on opening a new computer department in a school in Jeddah. (Alzaid, 1990). Moreover, the Ministry of Education has recently established the National Society for Computers and their Use. The main objective of this society is to promote better use of computers in secondary education (Al Riyadh, 1992b).

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1. A review of these studies is carried out in Chapters 2, 3 and 6.

However, despite this government interest in and support for computer education, computer facilities are still used only for computer studies purposes. The use of the computer to aid subject teaching has not yet been fully recognized or approached. With this in mind, this study was designed to investigate the possibility of obtaining greater benefit from the computer facilities available in secondary schools by using them to aid science teaching. The study focuses on problems and suggests possible solutions.

As part of this work, the computer provision in SA secondary schools was surveyed and the attitudes of science and computer studies teachers, science advisors, and science trainers, toward the introduction and use of computers for science teaching in SA secondary education were examined.

The data collected from SA were used to highlight the problems which may arise when computers are introduced into SA secondary school science teaching. The data have also been used to suggest solutions to some problems and to propose an approach to computer training for science teachers in secondary schools.

## 1.3 Objectives of the Study:

As mentioned above, the main aim of this study was to examine the prospect of the introduction of computers into SA secondary school science teaching, determining problems and suggesting possible solutions. It was designed to focus on the people and provisions which may affect this introduction. Thus, the following specific objectives were identified:

1) to carry out a review of the recent literature on the use of computers for science teaching in an industrial society;
2) to conduct a field survey of computer provision and services in SA secondary schools;
3) to assess attitudes to the introduction of computers into science classrooms among those Saudi Arabian educators who are involved in science teaching;
4) to identify problems facing the introduction of computers into SA secondary school science teaching; and, following from 3) and 4)
5) to suggest possible solutions to any problems facing the introduction of computers into SA science teaching, and to propose an approach to facilitate science teacher training.

## 1.4 Overview of the Experimental Research:

The field work was limited to what could be achieved by one person in a period of three months' field study.

The schools were selected from the three main cities of SA: Riyadh, Jeddah, and Madinah. The samples of science and computer studies teachers comprised all those teaching at secondary schools in these cities, who were provided with computers. The science advisors' sample included advisors from the LEAs based in the three cities, while all science teacher trainers in all SA universities were also consulted.

The research involved three field studies in SA: the preliminary, pilot, and main study. Seven instruments were used for the field work:

a) Three interview schedules were used in the preliminary field study for consulting science teachers and advisors, computer teachers, and science trainers.

b) Three types of questionnaire were used in the main field study for collecting data from science teachers and advisors, computer teachers, and science trainers.

c) In the main study, an interview schedule was used at a meeting with a senior official in the Ministry of Education.

## 1.5 Background to the Study:

The Saudi Arabian Ministry of Education (MOE) is the official organization supervising the education of male students throughout the Kingdom. It was established in 1952 for the purpose of planning and supervising a project aimed at the provision of general education[1] everywhere in the Kingdom (Al-Zaid, 1982). Similarly, the Presidency of Girls' Education supervises the general education of female students.

The most obvious characteristic of the educational system in SA, other than the separation between boys and girls, is its very tight centralization, with all aspects being subject to central control, with policy matters being legislated by the Higher Council of Education. Curricula, syllabuses and textbooks are uniform across the country. Educational administration is the responsibility of nine different government agencies throughout the Kingdom. (Al-Eissa, 1988)

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1. General education includes the elementary, intermediate and secondary stages of education.

The secondary stage consists of three years from grades 10 to 12. It has special characteristics because of the age of pupils and the related stresses of their education (Al-Zaid, 1982). Secondary education, like all general education, is free for all Saudi and non-Saudi residents. The intermediate school certificate is the only requirement in order to attend secondary schools. At the end, pupils receive a general secondary certificate.

In the ordinary secondary school system, after the first year pupils attending these schools may specialize in science or the arts, they receive their certificate in that area.

The Developmental Secondary School (DSS) was a new type of secondary school education, evolved as a result of the decision to adopt the Credit Hour System, aiming to provide skills and knowledge adapted to students' individual differences (Alzahrany, 1989). Some of the aims of DSS were:

a) to expand the scope of secondary education to include new curricula and programmes more in keeping with the perceived demands of modern Saudi society;

b) to prepare secondary school pupils for their careers and help them to participate effectively in the developmental plans of Saudi society by providing them with the appropriate training;

c) to prepare pupils for further and higher education in their chosen fields of study (Ministry of Education, 1986).

There are four fields of study, Islamic and Arabic Studies, Management and Social Science, Physics and Mathematics, and Chemistry and Biology (Table 1.1). The same objectives and fields of study, and almost identical curicula, have been retained for the 1992 Secondary Schools Project (SSP) which has replaced the Credit Hour System with the Typical Year System.

| **Knowledge bodies** | **Subject** | | | |
|---|---|---|---|---|
| | **Islamic & Arabic Studies** | **Manage. & Soc. St.** | **Physics & Math.** | **Chemist. & Biology** |
| Religion | 46 | 18 | 18 | 18 |
| Arabic | 40 | 14 | 14 | 14 |
| Soc. Science | 26 | 30 | 8 | 8 |
| Science | 9 | 9 | 53 | 61 |
| Mathematics | 5 | 17 | 35 | 31 |
| English | 8 | 8 | 8 | 8 |
| Computers | 5 | 8 | 5 | 5 |
| Statistics | 6 | 6 | 4 | - |
| Management | - | 35 | - | - |
| Sport | 3 | 3 | 3 | 3 |
| Draft | 3 | 3 | 3 | 3 |
| Total | 151 | 151 | 151 | 151 |

Table 1.1 Distribution of subjects through the four streams of SA secondary education

Computing, as a subject in its own right, was introduced as early as 1985, and then for boys' secondary education only. The DSS included three computer courses, accounting for 7.46 % of the whole curriculum. These courses were: Introduction to Computers, Introduction to Programming (BASIC language), and Computer Programming and Introduction to Information Systems (the contents of the three courses are outlined in Appendix A). These courses were distributed among the three years of the new secondary school system (Almallais, 1991).

The first compulsory year in the new system (SSP) involves two weekly computer classes, accounting for 6.1 % of the whole first year curriculum (Figure 1.1). The classes focuses on the introduction to computers.

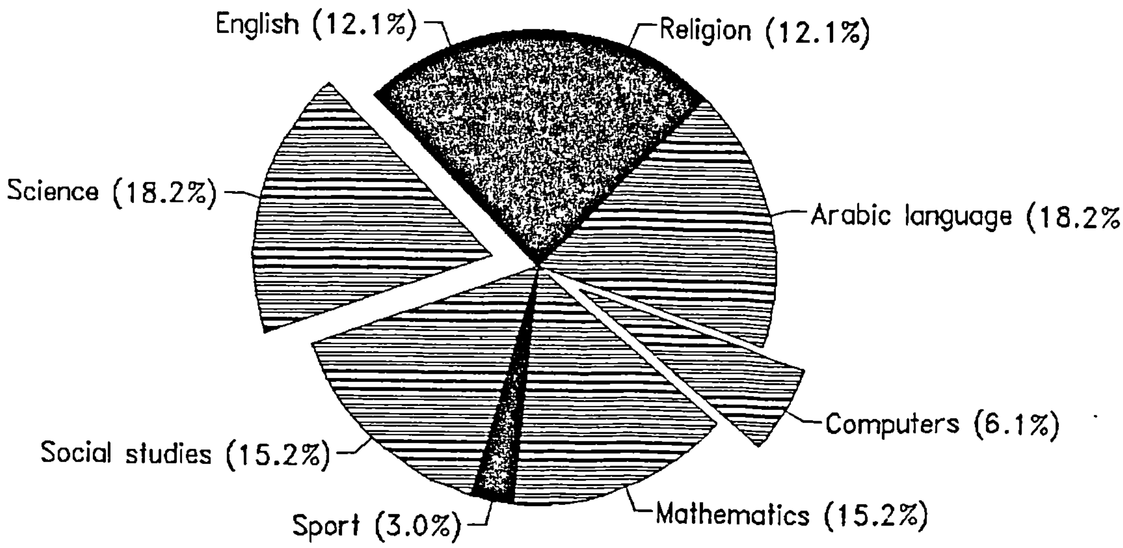


Figure 1.1 Distribution of the weekly classes in the first year of the new secondary education system (Source: Ministry of Education, 1992)

Table 1.1 and Figure 1.1 show that Science and Arabic have been given the greatest priority in secondary education. Although secondary education is concerned with only four science subjects, half of the choices of subject field given to the pupils are science subjects. 35 % and 40 %

of the whole curriculum of the two science streams are science subjects. The total science subjects account for about 20 % of the whole secondary education curriculum.

The balance of science subjects in the secondary schools is reflected in the large number of science teachers employed across the Kingdom. There are 2013 science teachers in a total staff of 9327; in other words, one teacher in five is a specialist in one or more science subjects (Centre of Statistical Data & Educational Documentation, 1992).

The nature of school science is also important. Computers have become an essential part of science teaching in the industrial countries. A wide range of educational software is available for various science subjects[1]. Professor R. Lewis, (the director of the Lancaster Institute for Educational Computing), claimed in 1984 that "the potential value of computers in science education is great, and it may not be long before they are considered as essential as the microscope and the oscilloscope are now." (Kahn, 1985)

In addition, the SA Ministry of Education has always recognized science and mathematics as the subjects most closely allied to computers, this explains the greater priority that has been given to encouraging science and mathematic teachers to teach computer courses.

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[1] Computer uses for science teaching will described in the next chapter and Chapter 6.

For example, in 1992 Riyadh LEA invited only science and mathematics teachers to attend computer courses which qualified them to become computer studies teachers (AL Riyadh, 1991).

## 1.6 Overview of The Thesis:

The remainder of this study comprises eleven chapters, as follows:

Chapters 2, 3 and 4 present the theoretical background to the study. Chapter 2 summarises the historical background to the introduction of computers into schools and various uses of computers for science teaching. A survey of the literature and problems relevant to the use of CAL in science teaching is presented in Chapter 3. Chapter 4 describes how teachers can be trained to use computers in their classrooms.

Chapter 5 discuses the preliminary study in Saudi Arabia. The first part of the chapter presents the instruments and the results of the study, while the second part gives some implications of the study.

The use of generic software, databases and spreadsheets in science teaching is explained in Chapter 6. Wordprocessors, electronic mail and datalogging are briefly presented in this chapter.

The main field work, the empirical study, is discussed in detail in Chapters 7 to 10. Chapter 7 describes how the main instruments were constructed. The Saudi Arabia pilot study and its results are also given in this chapter. The research design and methodology are described fully in Chapter 8, this includes data on the 266 science teachers, 15 science advisors and 16 science trainers who constituted the samples. The reliability and validity of the questionnaires are also discussed in this chapter.

Data analyses and relationships between variables of science teachers, advisors, trainers and computer studies teachers are presented and described in Chapters 9 and 10. Chapter 9 describes how the data of science teachers, advisors and trainers were analysed to examine relationships between sample variables and attitudes toward the use and introduction of computers into the science classroom. Statistical tables of the relationships between the scales and sample characteristics and background are also presented in this chapter. Chapter 10 summarises and analyses the responses given by 38 computer studies teachers.

Chapter 11 contains a discussion of the findings of the empirical study. Some problems facing the introduction of computers into Saudi Arabian secondary school science teaching are indicated in this chapter.

The study concludes in Chapter 12 with suggestions for course-design for science teachers, science teacher trainees and science trainers. Some other features related to teachers' computer training are also brought together in this chapter.

# CHAPTER 2 : :

# OVERVIEW OF METHODS OF USING COMPUTERS FOR TEACHING WITH SPECIAL REFERENCE TO SCIENCE

This chapter concerns the historical background of the literature presented in the next chapter. The intention is to give an account of the development of using computers for science teaching.

## 2.1 Introduction to the potential of the microcomputer:

"Only a hundred years ago, the very idea that a machine could be built to execute calculations was treated with ridicule and scorn." (Megarry, 1983, p.15)

Professor Tom Kilburn ran the first stock control programme on an experimental computer built by Manchester University in June 1948. The machine was big and weighed more than 60 000 pounds because it consisted of a series of metal office storage cabinets full of glass valves.

Initially, programs were written to test specific hypotheses, just as the early attempts at programming computers to play chess tried to specify in advance what strategies were to be followed (Hofstadter, 1979).

The major technological innovation which has been heralded as the 'computer revolution', is the development of the microcomputer in which all the processing functions are built into a single silicon chip. A microcomputer is simply a computer system whose central processing unit is a microprocessor. Computers, which had previously been expensive and occupied a large amount of space, were suddenly available at relatively low cost and become very much smaller in size. This marked the advent of the 'personal computer' (pc) (Terry, 1984).

Consequently it became convenient to consider using computers in a wide range of fields and applications. Medicine, the banks, the military, the share market and supermarkets are all being significantly affected by the computer. At the same time, businesses are changing to computer control and we are experiencing changes in the way information is generated, stored and transmitted. This revolution has taken place in a very short time. Educationists, like everyone else, have had visions of using these machines to make their jobs easier and to improve their product: 'educated children'.

Since the appearance of microcomputers, their use has gradually spread throughout the educational system (Ellington, 1989). In the earliest stage of the computer in schools, educators tried to consider how best to benefit from this new innovation, which cost more than any previous teaching aid. From an early stage, it appeared that computers could influence what is taught, how it is taught and who is taught. Therefore, as early as 1962, educators tried to guess the educational implications of computing for both teachers and students.

The ideas at the time were that society requires that every citizen must make judgments about risk and need, and such ideas involved far more abstract and scientifically sophisticated consideration than even a decade previously. How is one to take a stand on the proper use of new technology in education, medicine, genetic engineering, public services, and so on? As a basis for decision making public education must provide a foundation for all children that can allow them to cope with scientific and technological development (Disessa, 1987). It has been said that:

> "The present and future generations of pupils need education geared to what is likely to face them on leaving school... Education therefore has to take account of the new technologies and use them appropriately. It has to prepare pupils for life., ... It also has to educate them about some of the implications of the facilities which are, or soon will be, available if not commonplace. Just as computers have become an accepted part of life outside school, at work, in the home and for leisure, they have a part to play in the process of education itself." (Williams & Maclean, no date, p. 2-3)

It has been predicted that computers will bring about widespread and fundamental changes in schools, will change the curriculum, and bring about a new role for the teaching profession.

## 2.2 Courses About Computer and Computing:

The late 1960s and early 1970s saw the introduction of computers into the school curriculum and an increasing variety of courses. The introduction of computers in schools was intended to prepare pupils for:

a) living in the world of tomorrow,

b) working in the world of tomorrow.

The early idea was to study computers as part of the new technology, but most teachers regarded it as a branch of mathematics, so the main response to the call to teach programming was from those with mathematical ability. It was easy for mathematics teachers to transfer their teaching of binary arithmetic and logic to a computer context and to add on some programming. The link was a misconception, since there is little relationship between mathematics and the use of computers in education.

According to Ogborn (1986), the introduction of computers into schools was aimed at three broad groups of uses:

a) the computer used "as a computer" running a language such as BASIC, LOGO or PROLOG.

b) the computer running a program written with a specific educational purpose such as Drill and Practice, Simulation, etc.

c) the computer running a general applications program such as a database, spreadsheet, etc.

The current chapter discusses the first group briefly and the second group extensively, while the general applications of computers and their implication for science teaching will be addressed later in Chapter 6.

### 2.2.1 Computer Studies (CS):

Knowledge about computers in contrast with knowledge about the use of computers, begins with instruction in the operation of a computer and how it works. When computers first came into schools, it was suggested that pupils must understand what are the components of a computer system, how to turn the computer on and off, and how to load a program. Some instruction in basic keyboarding was deemed necessary, and pupils were expected to have a general understanding of how a computer program works. The study of these issues in relation to the storage and processing of data became known as Computer Studies. This was a minority subject for older and generally more able pupils.

In the UK, during the 1980s, Computer Studies (CS) was offered as a two-year specialist course dealing with the operation and application of computers, leading to CSE (Certification of Secondary Education) examination. Some schools had a policy of restricting the choice of CS to the most able pupils. The CS syllabus consisted of: preparing a substantial project, writing some BASIC programs, a study of computer hardware and software, the commercial and industrial applications of computers and social effects of computer use (Moore, 1989).

### 2.2.2 Computer Literacy (CL):

The term Computer Literacy (also known as Computer Awareness) is easy to use but more difficult to define. It is not the same as programming but does indicate understanding of the range of what computers can do and of how they do it. This understanding comes preferably from practical experience of the computer itself in various ways, including the applications of programs and high-level languages, and probably a small amount of programming. Computer Literacy also includes understanding the effects of the use of technology on the way information is utilized and of the role of the computer in a changing society (Allen, 1983). Computer Literacy therefore, might be seen as comprising the elements: knowledge about computers, knowledge of computer techniques, and knowledge about the social consequences of using computers.

The aim of Computer Literacy was to expand the study of computers to more pupils and to introduce more dimensions of computer applications in order to extend awareness of computers to the whole of society.

> "No book on computers in education would be complete without a discussion of the question: what is computer literacy? Surely, it is a goal of every school program to prepare students to live in a society where computers will affect nearly every area of life, and where an estimated 75 percent of all jobs will involve computers in a some way." (Naisbitt, 1982, p. 36)

There were some interesting projects for computer literacy during the seventies, for example, in the UK, Computer Awareness For All (1972), published by the National Computer Centre Limited. Later projects included: BBC Computer Literacy (1984), and Computer Literacy for Further Educational Colleges (1984). These projects aimed to enhance understanding of the concept of computer literacy and to make it an essential part of curriculum provision.

The main difference between CS and CL courses was that CS is an examination course for relatively few pupils, whilst CL is a study for all pupils and not examined.

The early introduction of computers into schools was aimed at preparing pupils to live and work in a technological society. It was only learning about computers and their use. Few teachers other than computer studies specialists expressed interest in computers as a school resource. In many schools this indifference enabled the computer studies departments to establish themselves as the rightful place for computers. But, in the early and mid 1980s, there was increasing consideration among the educators that the computer is a resource applicable to aid subject teaching in addition to learning specific computer courses; the move was towards integrating computers into all school subjects rather than restricting them to one.

Learning about computer use in special courses, such as CS and CL is not the substance of the current thesis. This thesis is concerned with the use of computers to aid science teaching; the contribution of computers to science teaching and their demands on science teachers' attitudes and training. The remainder of this chapter and Chapter 6 describe various uses of computers to aid science teaching, while issues related to teacher literacy and training are highlighted in Chapter 4.

## 2.3 Computer Assisted Learning:

Computer Assisted Learning (CAL) or Computer Based Learning (CBL), in contrast with CS and CL, uses the power and facilities of the computer as a tool to aid learning, just as industry uses computers as a tool for its purposes. The aim of CAL is to use computer technology to help pupils learn more effectively.

CAL is perhaps the most overused term current in the field of educational computing. Almost every piece of software bears the CAL label, while every approach featuring a computer is described as CAL. For some, it is a term used to describe one category of program (usually simulation) while for others it is collective acronym for all aspects of educational computing. CAL probably includes all these things and more (Wild, 1988).

For the purpose of this study, CAL will be defined as: "**the use of specifically-written or special purpose computer software inside the classroom to aid teaching**". This definition includes older types of computer use such as Programmed Learning, Drill and Practice, Tutorial; as well as more modern types such as Simulation, Games, Artificial Intelligence. The use of non-specific computer software such as generic computer applications is deliberately excluded from this definition.

Teachers spend a lot of time involved in administrative matters such as pupils' records, tests, and lesson plans. Nowadays, computers can do all these jobs for teachers easily and quickly. Using computers to carry out these jobs gives the teacher extra time to deal with the pupils and to advance the quality of their teaching work. This, of course, will improve teaching in an indirect way. However, computer administration is not specifically related to science teaching, therefore it will be excluded from the study.

Hudson (1984) described CAL as a breaking down of the information and skills into small pieces and claimed that it gives the opportunity for pupils to work at the learning task in simple, achievable stages. He claimed that CAL requires the application of two principal skills:

a) the ability to break down large bodies of information into smaller and smaller quanta of conceptual steps;

b) an ability to reconstruct the items in interesting, imaginative and relevant ways by means of well-written and well-presented frames.

There has been much confusion between the terms CAL and CAI (Computer Assisted Instruction), because some literature has leaned heavily upon the USA experience, where the term CAI tends to be used, whilst the term CAL is used in the UK. Another reason for this confusion is that the early work in educational computing often followed the 'programmed learning' path of the sixties, which was instruction rather than learning.

CAL stemmed and developed from a different educational philosophy, and has always followed changes in cognitive learning theories, since the majority of CAL types in schools adopt psychologists' ideas. Thus, different types of CAL stem from different educational theories.

In the classic form of CAL based on Skinner's ideas, the computer presents the student with a piece of text which is followed by one or more questions. These are usually of the multiple-choice type. The following section gives further explanation of the old and modern types of CAL.

## 2.4 Types of CAL and their Use for Science Teaching:

### 2.4.1 Programmed Learning:

The question of the use of computers in education arose for the first time in the United States as a result of psychologists' research and ideas on programmed learning (PL). It was suggested that learning occurs when a specific response from a learner has been elicited in response to a particular stimulus in a given situation. In effect, this meant providing children with a linear learning sequence and continual reinforcement. These ideas derived from behavioural psychology led to the design of individual PL systems.

According to the ideas of PL, teaching then becomes simply the arrangement of contingencies of reinforcement. The important event is considered to be positive reinforcement, which should follow only the occurrence of desired behaviour. The main contribution of PL to education was its emphasis on the importance of feedback and individuality. From the beginning, followers of this school of psychology contended that effective linear programming required mechanisation. Early behaviourists were supposed to be able to compare the student's response with the required answer, but given their reliance on push-buttons, this often restricted the kinds of answer that could be required, or demanded that the students should evaluate their responses for themselves (O'Shea & Self, 1988).

PL systems for science teaching were written by teams of science teachers, programmers and educators. The systems involved pictures, graphs and also laboratory work. It was claimed that student-computer 'dialogue' is better than a written instruction which the students just follow without any responses or interaction. So a change could be made to a linear program using the students' responses to control the material they see next. For example, to build a lesson in Logo:

```
.
.
120 MAKE'ANSWER ASK [WHAT IS THE REAGENT
    REQUIRED FOR THIS REACTION:
            C6H6---C6H5BR]
```

```
121 IF EQUALQ :ANSWER [FE AND BR2] THEN
    PRINT 'YES AND GO 130
122 IF EQUALQ :ANSWER [BR2] THEN
    SAY [YOU ALSO NEED SOME FE] AND GO 120
123 SAY [THIS IS AN ELECTROPHILIC
    PROMINATION]
124 GO 120
130
.
.
```

The 120 simply labels the frame. If the student responds correctly (line 120), the program GOes to the next frame (label 130), as with linear programs. If he responds wrongly (e.g. BR2), he receives an appropriate explanation or suggestion and is retested on the current frame until the desired responses is reached (O'Shea & Self, 1988).

In 1971 the National Science Foundation of America (NSF) decided to invest $10 millions over five years in two demonstrations of use of computers in education: the TICCIT and PLATO projects. These two projects involved PL in high level command languages. The main aim of TICCIT (Time-shared Instructive Computer Controlled Information Television) was to demonstrate that CAL could provide better instruction at less cost than traditional instruction. It was designed to be used as the main source for the delivery and control of instruction. PLATO (Programmed Logic for

Automatic Teaching Operation) aimed to demonstrate the technical feasibility of CAL and to develop curricula materials acceptable to instructors and students.

### 2.4.2 Microtext:

Microtext (MT) was an extension of one aspect of PL. It is an author language, allowing the writer, and perhaps the user to create on screen a page of text and/or graphs of the sort seen on a Teletext TV, without having to follow complicated programming procedures.

MT can be introduced to the classroom in two different ways: either by allowing the pupils to create their own text or by introducing a pre-prepared curriculum text to be followed and studied by pupils. The author can incorporate different colours and designs in the text.

The idea of MT was to involve an individual pupil in the process of deciding progress from one frame to another and allowing him to develop planned programs in a relatively easy language.

Examples of linear programming, PL and MT both emphasise the importance of systematic presentation, and assume that the learner gives precedence to the task over his own activity. Both tend to treat the learner as a 'blank format'. They are concerned with the capability of 'instruction' rather than the effectiveness of 'learning', seeing the process of learning as a gain of 'knowledge' rather than 'experience' and neglecting the attitudinal and emotional aspects. Both tend to ask the learner to follow instructions and to do what he is 'expected' to do rather than allow him to offer his own interpretations.

**2.4.3 Drill and Practice:**

After some applications of PL, the problem was to find a more effective approach than PL ideas. Ideas were adopted from arithmetic teaching, using the computer to present a new kind of learning: 'learning' rather than 'instruction', and 'training' rather than 'education'.

In Drill and Practice (D&P) lessons, the pupils are presented with a structured succession of exercise questions designed to give them practice in specific subjects. These questions can be written into a CAL package, drawn at random from a collection of suitable questions called an **item bank**, or generated within the CAL program. The program is able to provide reasonable random values for the calculation and then determine the correct result to check the pupils' answers. The sequence of examples can be arranged so as to provide questions of prespecified difficulty, or be graded in severity (Terry, 1984). The following example shows the dialogue with a D&P program (Palmer and Oldehoeft, 1975).

FIND THE EQUATION OF A LINE WITH SLOPE 10 AND Y-INTERCEPT 2.

Y=10*X+2

GOOD. LET'S TRY ANOTHER PROBLEM.

FIND THE EQUATION OF A LINE WITH SLOPE 5 AND PASSING THROUGH (10, -5).

Y=5*X-45

THAT'S INCORRECT. LETS TRACE THROUGH THE SOLUTION OF THE

PROBLEM TOGETHER.

STEP 1:FIND THE Y-INTERCEPT BY

$$5=(-5-Y-INTERCEPT)/10 \Rightarrow -5^{(*10)}+(-5)=Y-INTERCEPT \Rightarrow V-INTERCEPT=-55$$

STEP 2:STOP

OKAY. LET'S TRY ANOTHER PROBLEM.

.

.

GOOD.

...

.THAT'S VERY GOOD

.

.

After their illustration, Palmer and Oldehoeft (1975) claimed that no further significant development seemed possible other than the use of new modes of presentation, such as graphics. It was a limited approach, they said.

One major question about using D&P was how it could be used to teach some fields and topics; for example, the history of science, discovery of penicillin and so on. If we could put different sorts of problems in a logical order of difficulty, then we might be able to write a D&P; otherwise, probably not...

### 2.4.4 Tutorial:

The demands on the learner made by a tutorial program may range from simply following a sequence of actions which have been pre-specified by the author, to executing complex decision procedures that attempt to take into account a student model and course objectives. Since the authors of tutorial programs are responsible not only for specifying the material to be presented in each frame, but also for deciding which frame should be presented next, it is also necessary to set up an equally laborious tuning process (O'Shea & Self, 1988).

Many tutorial programs are content-centred, owing much to the work of the cognitive psychologists Bruner and Ausubel (Hartley, 1981). The original aim of tutorial programs was not only to test content and understanding of certain key issues, but also to use the program as a platform for discussion of wider issues that could not be predetermined as a set of instructional objectives. The subject allowed the author to provide a context for a more open-ended teaching strategy using the author language PILOT (Beynon, 1985).

Tutorial involves more independent flexible tasks than D&P. It can give the student more than one instructional path. For example, the SCHOLAR tutorial generated a subtopic on an essentially random basis. The science teacher, for instance, might specify the topic of 'Nuclear Physics', and SCHOLAR would select a subtopic like 'Nuclear Interaction', and then perhaps a sub-subtopic, e.g. 'Division of Electrons in Uranium Orbits'.

Each of SCHOLAR's agenda can be perceived in Clancey's(1979) description of a 'lesson plan' for GUIDON. The plan could be discussed, created by the tutor for each case. In later versions of GUIDON, a lesson plan is generated before each case session.

The National Development Programme for CAL in the UK (NDPCAL; 1973-1977) supported a wide variety of tutorial program types and subject applications. The programme was supported by seven government departments, and produced 35 studies and projects. Nine of these projects concerned engineering, mathematics, and science.

The first aim of NDPCAL was "to develop and secure the assimilation of CAL on a regular basis at reasonable cost". The second aim was "to make recommendations for future developments in the field and this obviously demands the collection and presentation of information" (Tawney, 1979).

CALCHEM (CAL in Chemistry) was an example of a science tutorial project established in 1974 within NDPCAL to produce a number of CAL packages in chemistry. It provided training and experience in designing, writing and testing of CAL packages in chemistry.

During the late seventies and early eighties, there was a strong sense of the need to introduce CAL into the secondary school science classroom because the main thrust of NDPCAL had been at the tertiary level. Questions were asked, such as: How can we train science teachers to help the students use CAL? How can we develop the hardware to make it suitable for CAL? Who should publish the software?. There were, at that time, no doubts about the value of CAL for the science classroom and laboratory, no questions about possible weaknesses or difficulties.

**2.4.5 Simulation:**

One of the best known forms of CAL in science was and perhaps still is, simulation, which has the aim of placing pupils in a situation they could not experience at first hand, to encourage them to anticipate, and have in mind, more than one line of enquiry.

It was thought that applications of computer simulation in the area of education were" ... perhaps the most exciting and potentially the most rewarding ... of all the possible applications of computers in education." (Dowsey, 1977, p. 59) Moreover, "Positive contributions occur in the laboratory and in the regular classroom. Students can learn independently and very rapidly...they can really get involved in the activity of learning." (Hounshell & Hill, 1989 p. 544)

Many of the CAL materials of direct interest to science teachers feature simulation, and publications such as *Journal of Computer Assisted Learning (Blackwell Scientific), Journal of Computers in Mathematics and Science Teaching (Association for the Advancement of Computer in Education)*, and *Journal of Research in Science Teaching (National Association for Research in Science Teaching)*, contain examples (up to the late eighties) of the classroom application of simulations across the science curriculum.

Science is about developing models of the content and processes of the real world. Constructing a model of reality is central to scientific activity. Computers can provide working representation of a model; one which students can investigate and explore. This was the idea behind introducing simulation into science teaching. Simulation programs can allow the student to supply information to the computer about variables affecting a process, and the program responds by changing its stored information in ways corresponding to how we suppose changes in real variables might affect the real phenomenon. The computer allows the student to see the results of these changes on the screen, by printing out numbers representing new values for the state of the system, by plotting points on a graph, or by changing graphic elements in an image representing the phenomenon. In this way, the students build their own understanding of the phenomenon they are investigating (Kahn, 1985).

For example, the EQUIL simulation allows the pupil to investigate the reaction and the equilibrium between ethanoic acid, ethanol, ethyl ethanoate and water. In one investigation, EQUIL invites the pupil to enter the 'initial concentration' for the compounds, whilst the computer displays the 'final concentration' in a table or a graph. If the pupil changes the values, then the screen will change, followed by new tables and graphs.

A computer simulation may be the only way to provide pupils a chance to see and understand scientific phenomena in the 'real' situation; deep in the sea or high in the moon, large as the earth or small as the cell. All of these can be displayed in the science classroom by using simulation.

With the PLANETARY MOTION ORBIT 1 and 2 simulations, the pupils are involved in some understanding of planetary astronomy. In one task, the program incorporates understanding of the relationship between the radius (R) and the period (T) for a family of four planets by inviting the pupil to enter data for R (in millions of m) and T (in days). The program displays the results in a table and/or a graph, then asks him or her: do you think this is the law? The pupil then changes the data until he/she gets the law of, for example, "Kepler".

Computer simulation is the only possible way to demonstrate some models based on many experiments, done over many years, in different situations. Take the case of the INSULIN simulation program: it brings together the results and theories of more than forty years of research and investigations in one program enabling students to study them in a very short time, compared to the traditional laboratory.

Later simulations aimed to allow pupils to make decisions, formulate strategies and develop social skills. For example SITING AN ALUMINIUM PLANT simulation allows the pupil to consider some factors including:

a) the source and cost of the raw material;

b) the cost of purification of the bauxite;

c the cost of transportation of raw materials to the smelter;

d) the cost of building a power station and generating electricity for the smelting process;

e) the location and size of the smelter;

f) the repayment of the capital cost of the plant;

g) operating costs, such as interest charge and repayment of capital;

h) environmental disruption to the area.

It was expected that through working with the SITING AN ALUMINIUM PLANT simulation, students could develop skills such as problem-solving, economic thinking, as well as positive attitudes to the environment.

There have been suggestions that computer simulation is the best alternative to traditional science teaching (see for example, Zietsman & Hewson, (1986), Woodward, et al. (1988), Hounshell & Hill, (1989)), but the question was, how far can we give the students experiences? The arguments for using CAL have moved from its effectiveness in aiding teachers, to its effectiveness in providing experiences for the pupils.

### 2.4.6 Artificial Intelligence:

An early definition of artificial intelligence (AI.) is still widely accepted, "Artificial intelligence is the science of making machines do things that, if done by humans, would be regarded as intelligent" (Cumming, 1988, p 9).

The main difference between AI and simulation is that in AI, the computer not only reacts to the student's responses, but also accounts for or helps him or her overcome his or her mistakes, weaknesses and difficulties.

The basic philosophy underlying AI is Piaget's ideas which are counter to the behaviourist tradition in Psychology. Piaget tried to change our understanding of children and what they know. He emphasised structure:

"The essential functions of intelligence consist in understanding and inventing, in other words in building up structures by constructing reality" (Piaget, 1970).

These structures are built by the child in interaction with the environment. So, knowledge is always structured in some way at all age levels. Piaget is not saying that the child's cognitive structures only change in some pre-established or entirely predictable way; the child is always considered to be the centre of activity, being constantly involved in self-regulating processes. Thus, to describe a theory of change, we need to be able to describe the process of change, exactly as AI's computational metaphor for thinking tries to do (O'Shea & Self, 1988).

Despite the lack of practical examples in science teaching, AI is one of the most active areas of research with respect to CAL. For instance in the UK, there are now strong AI centres in the universities of London, Lancaster, Sussex, Edinburgh, Exeter and also at the Open university.

One of the best examples of AI is MYCIN, which performs medical diagnosis. O'Shea and Self (1988) discuss it from two perspectives. First they use it as an example of some contemporary techniques used in the construction of artificially intelligent programs. Second, they explore the various educational uses to which this and similar programs might be put. Good accounts of AI can be found in Howe (1978), O'Shea and Self (1988), and Cumming (1988).

## 2.5 A Modern Position:

As CAL developed, doubts arose as to its success in the science classroom. It became clear that the original forms of CAL, i.e D&P, tutorial, and later simulation, were no longer internationally acceptable. There were calls to change the ways of using CAL in science teaching, within a few years from its introduction. Studies began to ask: are we sure that CAL has achieved our educational aims? What are the problems of using CAL in the science classroom? Are the students interested when they use it? Do science teachers use CAL effectively in their teaching? Is CAL the best way of using computers in science teaching? and so on. Alongside doubt about the effectiveness of CAL, there is increased concern about the cost and the time required to produce and test such programs. These questions and issues are addressed in the next chapter through a critical review of past and current studies in subject teaching generally and in science particularly.

# CHAPTER 3 : :

# REVIEW OF CAL STUDIES IN TEACHING WITH SPECIAL REFERENCE TO SCIENCE

## 3.1 Scope of the Review:

The purpose of this review is to provide as clear a picture as possible of trends in both reviews and individual studies concerning the effectiveness of CAL and its contribution to school subject teaching generally and science teaching in particular.

Several reviews of CAL studies carried out in the past few years have presented information about the use of CAL in education. The reviews mostly include the effectiveness of one or more type of CAL upon pupils' achievement, cognitive skills, attitudes, etc.

Most of the studies concern subject teaching in general. While there are relatively few science studies these normally show similar patterns as in the other subjects. The following sections present reviews of CAL studies in general as well as particular reviews of studies concerning science subjects.

## 3.2 Types of Review:

Three kinds of review have evolved over the past 20 years for summarizing research, and all are used in reviews of CAL cited. Although meta-analysis procedures were developed in 1976 and are commonly used by many reviewers, some reviewers still choose to use the box score method, whilst others describe study findings in the form of 'journalistic account' (Roblyer, et al. 1988).

**3.2.1 Early Reviews:**

One of the early published CAL reviews using the descriptive method was done by Vinsonhaler and Bass (1972) on 10 Drill and Practice studies in mathematics and language learning. They found that most of the studies had reported no significant differences between experimental groups taught by using D&P and control groups taught by traditional methods. However, after they subtracted the average gain in the control group in each study from that of the treatment group, in almost all studies, they found advantages in favour of the computer group, and in most of the studies, this advantage was statistically significant. They concluded by observing that questions of cost-effectiveness and comparative effectiveness with other media also had to be addressed.

The review of Thomas (1979) was focused on the use of CAL methods in secondary schools, but he also included some studies from both elementary school levels and the military. Effects on achievement, attitude, time reduction, retention and cost data were reviewed. He used the box score method to summarize the results of 60 studies. Although he concluded by saying that "the studies reviewed paint a positive picture from CAL" (p. 111), 36 of the 49 studies reporting achievement claimed results equal to those of the other method. The only variable which showed a clear-cut advantage for CAL methods was time reduction. He went on to conclude that cost factors continue to be an important factor in adoption of CAL.

### 3.2.2 Meta-analysis Reviews:

The meta-analysis technique was defined by Kulik et al. (1980) as

> "statistical analysis of a large collection of results from individual studies for the purpose of integrating findings...it uses multivariate techniques to describe findings and relate characteristics of the studies to outcomes." (p. 527)

The rationale behind meta-analysis is to subtract the impact of the control or traditional method from that of the experimental method or the one under study and thus estimate the impact the new method would have over and above the old one. This estimate called the "effect size" (ES), is usually calculated by subtracting the mean score achieved by the non-treatment group from that achieved by the group of the treatment under study. The result is then divided by a measure of the spread of scores achieved by the two groups: the pooled standard deviation. The following formula is used for the process (Roblyer, et al. 1988):

$$ES = \frac{\overline{X} - \overline{C}}{SD_p}$$

where, ES= effect size, X and C are the mean scores of the experimental and control groups respectively and $SD_p$= pooled standard deviation.

Cohen (1977) gives the following guide-lines for describing results of studies:

ES of 0.2 = small effect
ES of 0.5 = medium effect
ES of 0.8 = large effect

To give a continues range of values, Cohen's description can be modified to be:

$$
\begin{aligned}
ES &< 0.2 = \text{no effect} \\
0.2 \leq Es &< 0.5 = \text{small effect} \\
0.5 \leq ES &< 0.8 = \text{medium effect} \\
ES &\geq 0.8 = \text{large effect}
\end{aligned}
$$

Meta-analysis was used extensively by Kulik and colleagues from the University of Michigan in their reviews (1980, 1983, and 1985), and by Roblyer and colleagues from Florida University (1988). The meta-analysis technique was also used in three reviews of CAL studies concerning science teaching.

#### 3.2.2.1 Reviews of the Michigan University Team (MUT):

The first team-review was by Kulik, Kulik, and Cohen in 1980 which performed several meta-analyses on CAL from college level teaching. They integrated findings of 59 independent evaluations of CAL in college teaching. The 59 studies were selected from a pool of 500 studies because they satisfied three criteria. First, the studies had to take place in actual college classrooms. Second, studies had to report on quantitatively measured outcomes in both CAL and conventional classes. Third, studies had to be free from crippling methodological flaws; for example treatment and control groups had to be similar in aptitude and on other variables.

Kulik, et al. explained that the studies used in the meta-analysis described four major types of application of computer to learning: tutoring, computer-managed teaching, simulation, and programming the computer to solve problems. They described the outcomes in studies in terms of outcomes: student achievement, correlation between aptitude and achievement, course completion, student attitudes, and instructional time.

The meta-analyses findings showed that CAL made small but significant contributions to course achievement (ES= 0.25), and also produced positive, but again small, effects on the attitudes of students toward learning and toward the subject matter (ES= 0.18 to 0.24). CAL also reduced substantially the amount of time needed for learning.

Although the effect of CAL in the typical study of Kulik, et al. was small, effect sizes varied from study to study. Only one-quarter of the studies reported a medium or large effect in favour of CAL, whilst nearly three-quarter of the studies found small or trivial effects. Few studies (less than five percent) reported moderate or large effects favouring traditional learning.

But even the large effect size of some studies was not completely related to the use CAL, because when Kulik, et al. looked back carefully and examined whether the studies that reported large effect differed systematically from those reporting small effect, they found the average effect size was .13 for those studies in which a single teacher gave both computer-based and traditional groups of a course. Effects were larger (.51) when different teachers gave the two treatments. This could give indication of the influence of group-teacher interaction rather than the effectiveness of just the teaching method.

Later, the University of Michigan team performed two further meta-analysis reviews, these times at secondary level (Kulik, et al. 1983/Bangert-Drowns, et al. 1985). Both reviews found approximately the same effect size in achievement (0.32 and 0.26, respectively) and attitudes. Again, both reviews found small effects on scores of students' achievement, but in the 1983 review, they found very positive attitudes toward the subject among students who were taught using computers. Both reviews confirmed substantial reduction of time when students are using the computer.

<u>3.2.2.2 Review of Florida University Team (FUT):</u>

A more recent and comprehensive meta-analysis review of CAL was made by Roblyer, et al. (1988). They firstly made a comprehensive review and analysis of the findings from past reviews.

ERIC and Dissertation databases were used to locate studies which met their pre-set criteria. About 200 studies were gathered and read. Of these, only 82 studies could be included in their analysis due to insufficient data or lack of methodological information required by the authors; among them 26 were reviews of CAL. Some of their findings are:

. attitudes: attitudes toward computers as learning media were not significant, while significant different attitudes toward school subject were found.

. problem-solving skills: small effect by CAL in problem-solving skills. Only one study (out of four) had a high effect size, and two of the others had negative ones.

- content area: using CAL to teach cognitive skills (problem-solving, critical thinking) in science yielded the same effects as for mathematics and reading.
- grade level: effect sizes were higher at college and adult levels.
- reduction in learning time: eight reviews at various grade levels concluded that using CAL resulted in substantially decreased learning time.
- CAL type: drill works better with lower level skills found at lower grade levels, while tutorial is required for higher level skills. The success of the type of CAL depends on many variables, including the type of skill being taught and instructional/learning accompanying CAL.
- supplemental and replacement: CAL was more effective as a supplement. CAL as a replacement for the teacher seemed neither a practical nor an effective strategy, although early hopes had been high that CAL could reduce the high costs of education by eliminating the position of the teachers.
- ability level: six reviews at various grade levels found that slow learners and under-achievers seemed to make greater gains with CAL than more able students.

The main difference between the reviews of the MUT and those of FUT is that the FUT reviewed all grade levels (primary through adult), whilst a limited range of level was reviewed by each study of the MUT. The MUT included college level studies in the first review (1980) and secondary level studies in the reviews of 1983 and 1985. In addition, the FUT drew up more specific information about the findings such as content area, grade level, improving problem-soving skills, etc.

Although the FUT indicated positive effects on the achievement when using computers, this was not the case of the MUT, who found little contribution by CAL to the course achievement in all their three reviews. This difference could be explained on the ground that the FUT team included studies of more modern types of software and hardware. FUT reviewed studies of PLATO and TICCIT Mainframe computers with types of typical CAL such as D&P, tutorial, simulation and programming, and they included in addition to typical types of CAL, 13 LOGO studies and 10 studies using wordprocessor and some other business software. The high individual overall (ES) of each modern studies in the FUT review could confirm this indication.

Both teams claimed to show a reduction of study time in favour of CAL. The two teams also showed small or no significant effects of CAL on the attitudes toward the computer as medium of learning and toward the subject studied, although attitudes toward subject were more favourably affected than attitudes toward computer as a medium of learning.

**3.2.2.3 Science Subject Reviews:**

Aiello and Wolfle (1980), Willett, Yamashita, and Anderson (1983), and Okey (1985) have all reviewed studies of alternative methods of science learning. The first of these reviewed 115 studies between 1961-1978 on five kinds of individualized learning, including tutorial, CAL, personalized system instruction (PSI), programmed learning (PL), and combinations of these methods. The effect size for CAL was among the highest (0.42).

Willett, et al. carried out a meta-analysis to assess the effects of different learning systems used in science teaching as part of a large meta-analyses project initiated at the University of Colorado to examine the major research areas in the field of science education. Only 14 studies of the review were for computer treatments. CAL had an overall effect size of 0.01, i.e negligible.

Although Willett, et al. provide important information about systems being used in science teaching, it gave little information about particular types of CAL.

A recent science review was made by Okey (1985). He examined the studies on the effectiveness of CAL in the last 15 years. Some of his results are:

. CAL is effective in prompting learning.

. most studies show CAL to be better than conventional learning.

. supplementing learning with computers may be more effective than proving a total computer environment.

. young children are affected more powerfully than older learners and those of low ability more strongly than those of high ability.

The last result may be <u>not</u> a contradiction with the findings of the FUT who found greater success at older levels than at lower levels, because Okey was comparing secondary with elementary levels, whilst, the FUT were comparing adult and college levels with secondary and elementary levels. Both the two reviews found greater gains by CAL for slow learners than more able students.

The FUT commented on the effectiveness of CAL applications in science in particular. Three out of four CAL science studies were found to show a positive effect. The FUT concluded that students achieved significantly more with computer methods with simulations only when they used them to interpret results and make decisions about the simulated experiments. When students were required only to follow directions and calculate results, no differences were found between experimental and control groups.

## 3.3 Review of CAL Modern Studies in Science Teaching:

The current review aimed to summarise more recent studies of CAL which have been carried out in the field of science teaching. The intention was to give an overview of the nature of these studies according to types of CAL, year of publication, content area, grade level concerned, design and outcome concerned, as well as to examine the effectiveness of CAL in secondary school science learning.

Studies were located by several methods, including dialoguing educational databases and scanning journals dealing with science teaching and computers in education. Three educational databases and two educational journals concerned with computers in science teaching were found to be the most powerful sources of relevant studies. An initial pool of 495 studies and dissertations was gathered according to general keywords and key phrases such as "Computer", "Science Teaching or Classroom", "Science Learning," as well as specific ones like "Simulation" and "Computer Assisted Learning". The search was done through:

. Dialoguing searches of *ERIC*, a database on educational materials from the Educational Resource Information Centre (1982 to date) (97 studies),

. Dialoguing searches of *HILITES*, a database on computer in humanities materials from HCI Information and literature Enquiry (1986 to date) (187 studies),

. Dialoguing searches of *Dissertation Abstracts*, a database on academic dissertations from IUM (1984 to date) (184 dissertation),

. Scanning *Journal of Research in Science Teaching* (1985 to date) (15 studies),

. Scanning *Journal of Computer Assisted Learning* (1985 to date) (12 studies).

All of the 495 studies were read, although most of this number had to be discarded according to pre-determined criteria: studies were required to have experimental or quasi-experimental design. Only studies available from 1985 were included, because this was the date when the last science subject review (i.e Okey, 1985) took place. Some studies had to be omitted because of insufficient data. Only studies concerned with science subjects in general education, primary to college, were included; studies in university and nursery levels were excluded.

Of the total number, 47 studies and dissertations were retained for the review[1]. Tables 3.1 and 3.2 summarise these studies. The first table classifies them by grade level and outcome. It shows that most of the studies were based on the higher levels; the secondary and college levels occupied more than two-thirds of the studies. Only a few studies were based on the primary level. This may be because CAL primary studies deal with all subjects, rather than science only, as many modern primary schools adopt on integrated curriculum, with a "topic" or "project" approach. Therefore, primary studies include, as well as science, other subjects not relevant to this review.

| **Year** | **Grade level** | | | | **Outcome** | | | | | | | | **Control group** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Pri.*** | **Mid.** | **Sec.** | **Co.** | **Ach.** | **Att.** | **C-skills** | **P-S** | **Interact.** | **S-C** | **Cost** | **Time** | **T** | **CAL** | **No** |
| **1985** | | | 3 | | 1 | 1 | 1 | 1 | | 1 | | | 3 | | |
| **1986** | | | 4 | 1 | 2 | | 2 | | | 1 | | | 3 | 1 | |
| **1987** | | 2 | 4 | 1 | 3 | 1 | 3 | 1 | | | 1 | 1 | 3 | 1 | 3 |
| **1988** | | | 2 | 2 | 3 | 1 | 1 | 3 | | | 1 | 1 | 3 | | 1 |
| **1989** | | 2 | 3 | 6 | 8 | 5 | 4 | | 2 | | 1 | 1 | 5 | 2 | 3 |
| **1990** | | 2 | 3 | 7 | 4 | 4 | 3 | 4 | | 5 | | 1 | 8 | 3 | 2 |
| **1991** | 2 | 2 | 1 | | 2 | 1 | 3 | 2 | | | 2 | | 2 | 2 | |
| **1992** | | | 1 | 1 | | | | 1 | | 1 | | | 2 | | |
| **Total** | 2 | 8 | 20 | 18 | 23 | 13 | 17 | 11 | 2 | 8 | 4 | 3 | 29 | 9 | 9 |

* Pri= Primary, Mid.= Middle, Sec.= Secondary, Co.= College, Ach.= Achievement, Att.= Attitude, C-skills= Cognitive skills, P-S= Problem-solving skills, Interact.= Interaction, S-C= Science concepts, and T= Traditional teaching method.
Note. Some studies included more than one grade level.

Table 3.1 Descriptive summary of CAL modern studies in science teaching

1. See a full list of these studies in Appendix B

Although most of the studies concerned students' achievement, there has been an increase in studies emphasising cognitive and problem-solving skills, whilst attitude is still one of the main considerations of computer studies in education.

Table 3.2 shows that simulation is the CAL type most used. 19 out of 47 studies used simulation. This could reflect the common use of simulation in the schools in the early and late eighties, arising from the expansion in its use in science classrooms during the previous decade. Hartley (1988) confirmed this point after he had looked back on previous CAL studies in science teaching by saying: "Many of the CAL packages in science feature simulation" (p. 59).

| Year | Type of CAL | | | | | | | Content area | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | D&P* | Tut. | Sim. | IA | CAL | Lab. | Total | Pyh. | Chem. | Bio. | Science |
| 1985 | 1 | | 1 | | 1 | | 3 | 1 | 1 | 2 | |
| 1986 | | | 4 | | 1 | | 4 | 2 | | 3 | |
| 1987 | | 1 | 3 | | | 3 | 7 | 1 | 1 | 1 | 3 |
| 1988 | 1 | | 1 | | 2 | | 4 | 1 | | 2 | 1 |
| 1989 | 1 | 2 | 3 | 1 | 1 | 4 | 11 | 2 | 3 | 4 | 3 |
| 1990 | 1 | 3 | 5 | 1 | 2 | 5 | 12 | 3 | | 7 | 2 |
| 1991 | | 1 | 1 | | 2 | | 4 | | | | 4 |
| 1992 | | | 1 | | 1 | | 2 | | | | 1 |
| Total | 4 | 7 | 19 | 2 | 9 | 12 | 47(53) | 10 | 5 | 19 | 14 |

* D&P= Drill and Practice, Tut.= Tutorial, Sim.= Simulation, IA= Artificial Intelligent, CAL= no specific type, Lab.= Laboratory, Phy.= Physics, Che.= Chemistry, Bio.= Biology.
Note. Some studies has more than one type of CAL.

Table 3.2 Descriptive summary of modern studies on CAL in science teaching

Table 3.2 also shows the rapid increase of laboratory studies during the late eighties, which would explain the large number of studies concerned with Biology; almost all of CAL laboratory studies were carried out for Biology topics.

Roblyer and his colleagues found the number of studies from 1980 to 1987 to be 85. Of these, most were reported during 1984-1987. In this review, the number of studies changed dramatically during the second half of the last decade and early this decade (Figure 3.1). In the beginning, the number was increasing (as Roblyer, et al. found) and reached its highest during 1989 and 1990, but so far it seems that there is a decline in the first two years of the nineties.

The lack of CAL studies during 1991 and 1992 could be explained by the rapid increase use of general software applications launched into modern schools in the early nineties. Of course, the increased use of these types would decrease the use of CAL (as defined in this thesis), and therefore CAL studies.

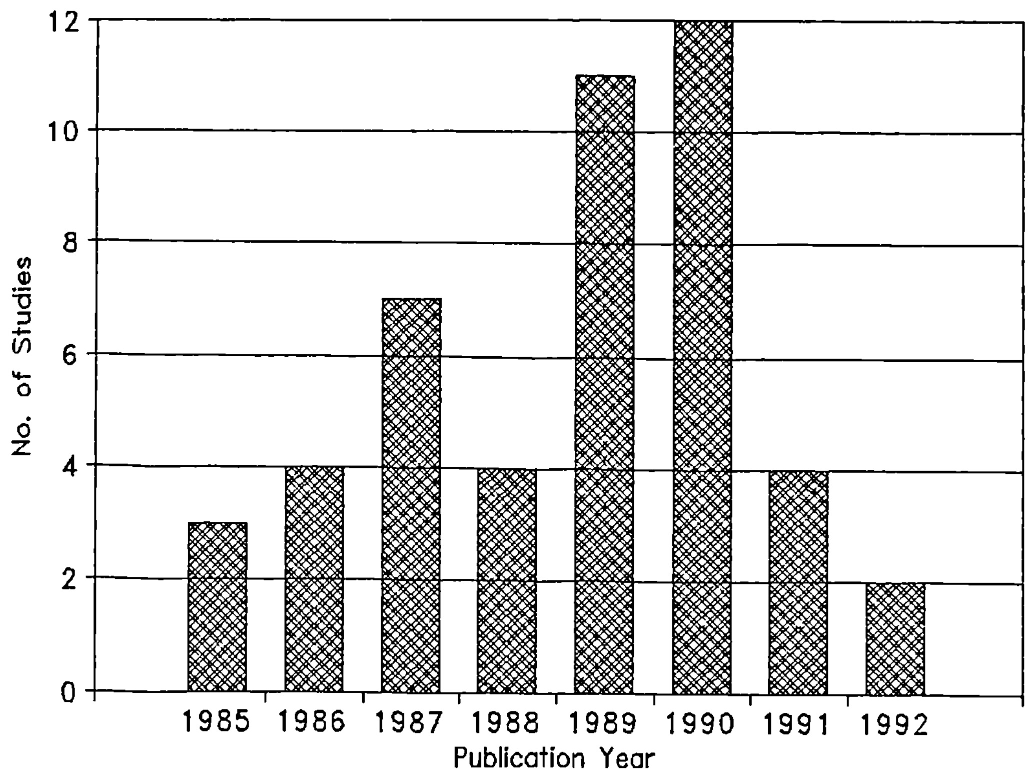


Figure 3.1 The relationship between year of publication and number of CAL studies

One of the main aims of the current review was to investigate the effectiveness of CAL in secondary school science teaching, to confirm and support the scope of the thesis. For this reason, more conditions were placed on the studies analysed in order to have a clear indication of the effectiveness of CAL in secondary school science teaching. The new conditions were that the studies took place in actual secondary (high) school science classrooms; laboratory studies and those with handicapped or special groups were excluded. Studies had to have a control group, i.e, two-group design.

Out of the 47 studies included in tables 3.1, 3.2 and figure 3.1, 10 studies were able to be included in the more restricted secondary school review. Table 3.3 summarises the findings from these studies.

| Author | Year | Country | Type of CAL | Content area | Description | Finding * |
|---|---|---|---|---|---|---|
| Dalton | 1985 | USA | CAL | Biology | Effectiveness on achievement and attitudes | + |
| Howard | 1985 | USA | Simulation | Biology | Effectiveness on problem-solving | + |
| Wainwright | 1985 | USA | D&P | Chemistry | Effectiveness on concepts | - |
| Rudolph | 1986 | USA | IA | Physics | Effectiveness on performance | |
| Zietsman & Hewson | 1986 | S.Africa | Simulation | Physics | Effect on conceptual change | + |
| Rivers & Vockell | 1987 | USA | Simulation | Biology | Effectiveness of scientific pro-solving skills | |
| Choi & Gennaro | 1987 | USA | Simulation | Earth | Effectiveness of simulated experiences | |
| Snir J, et al. | 1988 | UK | Simulation | Physics | Effective on conceptual change and Problem-solving skills | |
| Wainwright | 1989 | USA | Commercial | Chemistry | Effectiveness on Achievement | - |
| El-Sanhurry | 1990 | USA | Tutorial | Physics | Effectiveness on achievement and attitudes | |

* += positive findings in favour of CAL method, -= positive findings in favour of control method, no sign= no significant difference between the two groups

Table 3.3 Descriptive summary of modern studies on the effectiveness of CAL in secondary level science teaching

While the 47 studies contained a majority of Biology studies, the 10 studies of Table 3.3 represented different science subjects (Physics, Chemistry, Biology and Geology) in nearly equal numbers. These studies also showed use of various types of CAL.

Half of the studies showed no significant effect for the CAL treatment groups. Furthermore, Wainwright (1985) and (1989), found in favour of the control groups (traditional learning), although he included immediate feedback, response checking, and error avoidance in his software package. He claimed ...

> "In spite of numerous studies in which CAL treatments in chemistry have resulted in higher achievement, this investigation has suggested that the traditional worksheet approach is more effective than CAL, even when using a software package respected by educators for its instructional design." (1989 p. 78)

This indication matches the conclusions of Roblyer, et al. described above, because they found four analyses resulted in effect sizes which were negative or not significantly different from zero.

To be included in Table 3.3 each study has been required to use the control group design, which compares the results of an experimental (CAL) group with a control (traditional method) group, with the same teacher or one of similar standard.

The experimental and control groups design may be seen as an "unequal comparison", because it is not just a comparison between two teachers, but it is a comparison between one teacher in the control group, against a team of programmers (authors), computer(s) and the experimental group's teacher. Therefore, any significance in the result should not be explained as a success for the CAL only, but for the whole team. Rosenshine reminded us (in 1971) about this "source of invalidity" by pointing out that specific teaching behaviours, rather than different types of teachers compete to influence learning. Clark (1983) went further by saying:

> "It seems reasonable to advise strongly against future media comparison research. There are no learning benefits to be gained from employing different methods of instruction, regardless of their obviously attractive features or advertised superiority. All existing surveys of this research indicate that confounding has contributed to the studies attributing learning benefits to one over another and that the great majority of these comparison studies clearly indicate no significant differences." (p. 450)

Table 3.3 shows that some modern studies concern problem-solving skills, which is seen as an important issue in science teaching. It was thought that simulation could provide students in the science classroom with enough practice in novel problem solving to help develop a generalized skill in scientific problem-solving (Minsky and Solomon, 1985). In two studies of computer simulation enhancement of problem-solving skills in Biology and Physics, Rivers and Vockell (1987), and Snir, et al. (1988) found that students using simulations met the unit objective no better than control students and that simulation does not help students in developing problem-solving skills. These typical studies raise serious doubts as to the effectiveness of simulation in developing students' problem-solving skills. Hartley (1988) has argued that a modelling system is better than simulation for developing these skills. Modelling allows the students not only to learn about the science topics-domain, but also to develop investigatory and problem-solving skills.

## 3.4 Problems of using CAL in science teaching:

Studies of CAL in science teaching mostly follow the development of the categories discussed previously and the era in which CAL was most used. In the earliest stage of each category there was a surge of enthusiastic studies, which claimed high benefits from the use of CAL. Later on and after a period of application, other studies with little gain argued for more caution in interpreting claims.

One problem limiting the use of CAL is its cost in both money and time to develop materials. Several studies have suggested that CAL needs specialists to spend many hours producing programs to teach a particular topic, which may be taught by a simpler and cheaper method, with greater cost effectiveness (Hartley, 1988).

Fielden (1979) has listed the main components of the cost of CAL as:

- the capital and recurrent cost of hardware;
- the use of computer time on existing installations;
- equipment maintenance;
- the time of specially recruited or funded staff;
- the time of existing staff;
- accommodation;
- share of overheads and services,
- travel, promotion and subsistence expenses.

Hooper (1977) in the final report on NDPCAL, claimed that the cost was about £5,000,000 which was much more expensive than any other innovative teaching method. The report showed that the cost of a student hour of CAL was more than £4 and would be in the range of £5 to £10, while the cost of conventional teaching at that time was in the range of 69*p* to £2.50 per student hour.

The report also indicated the cost taken to develop CAL packages, which had the range of 200 to 400 hours of effort in their development. Hooper pointed out:

> "Thus, the point must be made that there should surely be some advances in teaching technique which are 'worthwhile' despite their extra cost. CAL and CML are however extremely high cost technologies and are the most expensive tools yet introduced into the teaching process." (Hooper, 1977, p. 78)

Although Fielden and other early evaluators argued about Mainframe computers, the cost problem remains even with stand-alone machines. It is a software-cost rather than just machine-cost. Even if microcomputer time at present is effectively free, software production, testing, and time problems remain. This indication is supported by many CAL studies and reviews. Roblyer, et al. in (1988) stated that "since using computers in this way means substantial increases in costs of instruction, it would probably be cost-effective to use computers in this area only if they were also being used for other purposes at the same time." (p, 32)

Another problem which is linked to the cost-problem is the quality of the software. This problem has always dogged the development of CAL, but it seems to have become a major problem in recent years. The National

Association for Research in Science Teaching (NARST) focused on this problem in their annual meeting in 1985. Two of the four papers criticised 'less than optimal software' (Hale, 1986). Even when using a software package respected by educators for its instructional design, the problem still exists (Wainwright, 1989).

Kracjik, et al. (1986) confirmed this problem ... "The use of less than optimal software in research studies was a problem that received little attention ... It certainly deserves more attention in the future." (p. 467)

Attention should move from thinking about how CAL can be used in the classroom toward examining the benefits of using it. Maddux (1988) stressed this by saying: "Thus, if software houses elect to market software that is not consistent with what is known about how people learn, the burden of proof that the software is efficacious should lie with the developer." (p. 4) He stressed that the software should help the students not just to investigate scientific phenomena, but also to develop their problem-solving skills.

In non-English speaking countries, the software problem is even more complex. CAL software circulates internationally from its country of origin which is most often an English-speaking country. Carnoy, et al. (1987) stated three problems created by the use of imported CAL software:

1. the unsuitability of software for curriculum being used;
2. linguistic problems for countries where English is not spoken,
3. cultural problems in terms of the models inherent in the software.

Herbenstreit (1984) stressed this idea by saying:

> "Willingly or not, the educational software designed in a country carries with it, in many subtle ways, the social and moral values of culture of that country and therefore the massive use of educational software designed in a foreign country will slowly but inevitably lead to a transformation and eventually to a decline of the originality and specificity of the national culture and traditions. This kind of difficulty is already well known regarding school books in general but it is much more difficult to analyze in the case of interactive educational software packages." (p. 16)

Finally, and perhaps most crucially, are the doubts about the reality of the effectiveness of CAL. Some of the discussed reviews and studies show little sign of the benefit of CAL in the classroom. Laurillard (1992) pointed out that "many researchers and developer of CAL have built simulation and microworlds on the assumption that the enriching experience they provide will help to develop students' understanding. But there is little scientific evidence as yet that tells us what these experience are, how they help the student, or how the computer's contribution is essentially different from other teaching methods." (p. 156)

Although Roblyer, et al. and Kulik, et al. claimed that CAL can reduce the learning time, nearly three quarters of studies in their reviews showed trivial to small effects (ES= 0.10 to 0.30). The claim of reduced time for learning was rejected by Clark (1983).. "A plausible rival hypothesis here is the possible effect of the greater effort invested in newer media programs than in conventional presentation of the same material." (p. 449) The students in the treatment design are given additional help compared the with traditional method, and this, of course, produces more effective presentation requiring less time to complete.

Additional hypotheses against the effectiveness of CAL were also raised by Clark. He has suggested that journal editors select for publication research that finds stronger effect for newer media. Kulik, Bangert and Williams (1983) reported effect sizes of .21 and .3 for unpublished and dissertation studies respectively, while published studies showed an average effect size of .47. Kulik, et al. (1980) found similar evidence in an analysis of audiotutorial instruction studies. Published studies showed a 3.8 percent final examination advantage for audiotutorial methods over conventional instruction, but this reduced to a 0.6 percent advantage for the same method in unpublished studies.

Wainwright (1989) summarised the argument by pointing out

> "Although numerous studies have been published in which CAL was the favoured instructional method, this study suggests caution in adopting the general assumption that CAL in more successful than traditional method. A careful study of the literature reveals that in the vast majority of cases in which CAL was favoured, subjects was volunteers rather than randomly assigned, and often used CAL as remedial or supplemental instruction, beyond that which the control group received. These voluntary and enriched approaches may, in fact, be optimum applications for CAL, rather than required, controlled, whole-group instruction such as in this study." (p. 284)

## 3.5 The Role of Teachers in adopting CAL into Schools:

A further CAL-related difficulty facing educators today is that most teachers do not use computers. Educators then start to argue seriously that there is no need to introduce computer facilities, which cost a lot, if teachers are not willing to use them.

Lehman (1985) found no use of computers by science faculty in 41 percent of 340 USA high schools he surveyed. Overall, of the 1,470 science teachers in his study, Lehman found 77 percent did not use computers in teaching. Similarly and in the same year, Kherlopian and Dickey (1985) found that 60 percent of K-12 teachers were not using computers in the classroom. Mitchell (1988) surveyed a random sample of 2000 secondary science teachers. Few teachers were found to be users (17 %), with more teachers (40 %) "anticipating use of computers within the next two years".

The National Science Foundation (NSF) study by Weiss (1977) showed that only 9% of science classes grades 10-12 ever use computers, although 36% of high schools have them. Six years later, another survey this time by the National Education Association (1983) indicated little improvement in the use of computers. It showed that 82 percent of practising teachers want and need training in using the computers.

The National Science Board of the United States (1983) stressed the urgent need for training science teachers in using computers: "The most critical need is to train teachers in the uses of technology in the education of children", it says.

Inadequate teacher training contributes to the lack of computer use, McCarthey (1988) stated that "Certainly, more and more comprehensive teacher training would help drive the revolution forward." (p. 43) He argued that we all made a serious mistake in giving the computers to the kids first. We ignored the teachers, cut them out of the loop, and that is precisely the way to kill a promising educational technology. What we should have done is given adequate training to the teachers before asking them to start using the computers. Once teachers have learned what a computer can do, they can understand comfortably and intuitively, how to make it fit into a lesson or a curriculum. Ray (1988) went on to say:

> "After you find out about technology and its capabilities, then you must find out what the teachers think. Teachers are the bottom line, the keystone of this whole revolution. We must find out what teachers want and then determine if the computer can provide a solution. Throwing technology at educators has not worked, obviously; though it has informed us that computers are not self-evidently pedagogical devices." (p. 44)

## 3.6 Summary:

The previous chapter has shown that the introduction of CAL into science teaching came through a series of stages starting with CS and CL, then shifted to include science teaching in PL, D&P, simulation etc. It has also shown that the introduction of computers depends on the capabilities of schools and society.

Chapter One has shown that computers have recently been introduced into Saudi Arabian secondary schools for CS purposes; there is some speculation that it might be worthwhile using them in science teaching also. The problem of introducing computers into the Saudi Arabian science classroom may appear through the question: How best can we start to introduce computers into Saudi Arabian science teaching? CAL is usually used for science teaching in the science classrooms of industrialised countries, and it has been associated with some problems, discussed previously. These problems must also be addressed when thinking of using computers in the SA science classroom.

Moreover, the problem of adequate software would be greater in Saudi Arabia. Language is one of the main problems facing the Saudi Arabian computer specialists. At present, there is no Arabic computer language, which causes the secondary schools to teach BASIC computer language in English in the computer studies subject.

Finally, whatever the <u>potential</u> benefit of computers, there is no <u>actual</u> benefit from their introduction into science lessons if science teachers are <u>not</u> willing and able to use them. Therefore, before planning to introduce computers into Saudi Arabian science teaching, there is a need to investigate whether Saudi Arabian science teachers are willing and able to be trained to use computers in their teaching. This is the main purpose of carrying out the two field studies in SA. The preliminary study is explained in Chapter Five, while the main study is fully discussed in Chapters Seven to Ten. Before that, Chapter Four will give further explanation on the important methods, content, etc. of the teacher training and literacy.

# CHAPTER 4 : :
# TEACHER LITERACY AND TEACHER TRAINING

As with any curricular innovation, healthy development arises from a close liaison between training and classroom practice, i.e. the two stages should be mutually dependent. Assisting teachers to become technically literate and competent in using computers in the classroom is one of the roles of teacher education (Gardner and Megarity, 1988) and it is on this area of teacher education that this chapter will focus.

## 4.1 The Significance of Teacher Training:

The growth of information technology (IT) in schools has been rapid. In one recent year, a fifty-six percent increase was reported in the use of computers in the schools in the United States. Similar increases have been reported in England, France, Australia, and many other countries (Cachapuz, et al. 1991).

Unless the question of teacher education is addressed the potential of computer use in schools will not be realised (Sutherland, et al. 1990). At the heart of instructional computing are the teachers. It is teachers, not computers, that teach. It is essential that teachers gain an understanding of the educational capabilities of this technology in order to be able to identify when and when not to computerize their instruction.

Practising teachers require to gain this knowledge via specific in-service training directly related to the ways in which they will need to use this technology in their daily teaching (Langhorne, et al. 1989).

It has been shown in the previous chapter that many teachers do not use computers, even when they are available in schools. It was suggested that the main reason for this is that the teachers have little or no training to give them confidence and familiarity with the machines.

In the early 1980s there was considerable pressure in the industrial societies that computer literacy should be required of all teachers. Recommended training content included writing a simple program, knowing computer terminology, discussing the history of computers, and discussing the moral and human impact issues related to computers (Martin and Heller, 1982). In the USA, for example, the major statewide INSET for secondary science teachers in Pennsylvania has for several years been computer training (Abdel-Gaid, et al. 1986).

To meet the need for teacher training many programmes were developed such as the Microelectronic Education Programme (MEP) in the UK which ran from 1981 to 1986 at a cost of £23 million and provided training for 100,000 teachers. It also generated around 2,000 computer programs to help teachers introduce computers into their classrooms.

The incorporation of information technology (IT) within initial teacher training (ITT) is currently a major concern of the British Government, the Council for Accredition of Teacher Education (CATE) and of the teacher training institutions. For example, the Initial Teacher Education and New

Technology Project (1990-1992) which was funded by CATE has stated that all initial teacher training courses should contain compulsory and clearly identifiable elements which enable students to make effective use of information technology in the classroom (DES, 1989a). It has also recommended that all newly qualified teachers should be able to use information technology for their own purposes and in their teaching, and be able to evaluate its impact on teaching and learning.

Despite the extended programmes, training teachers to use computers in their classroom is still a common problem facing schools. The DES (Department of Education & Science) in the UK conducted a survey in 1988 which showed that only about a half of all teachers had undertaken initial awareness training in computers (DES, 1989b). In 1992, Mellar and Jackson made a survey of nearly 400 PGCE primary and secondary students. Two thirds of these students were found to have little experience of using computers either at home, school, college or work. Most trainee teachers gave high training priority to learning how computers can be used in teaching.

Even now, the recent survey of NCET (1993) shows that about half of science teachers had no computer training. Challenging questions confront educational leaders, such as: What should be taught to teachers? Who can do the training? Should all teachers be expected to train? Should the content be the same for all teachers? When should the training occur? Who has the responsibility: the schools, the teachers, the LEAs, or the Universities? (Langhorne, et al. 1989). Langhorne and his colleagues' questions echoed earlier comments of Turkel and Chapline (1984) who stated that "the important questions dealing with what will be needed in the field are not readily answered." Others stressed that "if teachers have well-designed and appropriate software, very little training would be needed for the majority of teachers." (Rockman, et al. 1983) While definitive answers to these questions may not yet have been found, some of the issues can be addressed.

## 4.2 Content of Teacher Training Programmes:

There is emerging a much greater role for the use of computers and the applications of IT across the spectrum of subject-teaching. To support this, the training programme will need a structured approach to training. There are many more computer training models for in-service training programmes than there are for pre-service programmes. Lewis (1983) has defined a model of IT in-service provision which focuses on the type of participant attending the courses. His outline includes a number of levels:

a) familiarisation level;

b) specialist curricular level;

c) teacher-author level;

d) teacher-disseminator level, and

e) advisor-inspector level.

An empirical programme of inservice training was run by Sutherland, et al. (1986-1988)[1]. Their computer-based INSET programme which was carried out for secondary mathematics teachers aimed to:

a) help the teachers become confident in using computers for themselves;

b) structure computer environment within teacher classrooms, and

c) enable teachers to evaluate the role of computers in terms of pupils' learning.

The DES (1989c), in their final submission (known as the Trotter report), described the level of IT capability they would look for in initial teacher training under three headings: practical IT skills; relating IT to the curriculum; and managing and evaluating IT use.

It seems that teacher training programmes should first build-up teachers' confidence, followed by training on use of some computer applications. The last stage of specific computer training can then be directed to applications in each individual subject (Hoyles, et al. 1990).

The following sections discuss the content of each of the three stages of teacher training including a practical training directed to science teachers.

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[1]. The programme will be discussed extensively in Chapter 12.

### 4.2.1 Basic Training:

Many teachers need to be given opportunities to develop some very elementary computer skills, because in many cases subject teachers have not yet taken the first steps towards using the computer as a teaching and learning aid.

Basic teacher training aims to foster positive attitudes toward computers where high levels of teacher anxiety are common. Summers (1990a) investigated the feeling of 173 PGCE (Post Graduate Certificate in Education) students. He found that 32% of the students started the PGCE course with a 'nervous' feeling toward computers. Bliss, et al. (1986) reported very similar findings. More than half of the teachers in their study had deeply rooted worries or criticisms concerning computers. Among these were 'anxieties and feelings of inadequacy'.

Basic training should include computer awareness including on introduction to the use of computers in schools, i.e the importance of computers in society, the need for educational computing, ways of using computers in schools (IT across the curriculum), and some basic training such as: how to switch the machine on and off, how to load the programs and save documents, and use of computer networks in school, etc.

Although some teachers may have taken some courses in computers, they still need basic training in the schools, because many courses run by Universities and Institutes are not exactly what teachers need in their classrooms. Goler (1990) found in his survey that there were no significant differences between older teachers and those recently qualified in their use of computers, computer confidence or knowledge of programs. A recent HMI survey of information technology in ITT revealed that one-fifth of tutors had little or no knowledge of information technology; one-fifth were aware of a broad range of IT applications but did not use IT in their personal work or teaching; one-fifth had the ability to use specific IT packages in their personal work but did not use IT in their teaching; one-fifth had the ability to select the use of IT appropriately in their teaching of students whilst only the remaining fifth thought that they had the ability to help students use IT in their teaching in schools (DES, 1991). Thus, any particular student has only a one in five chance of being supervised in the course of school experience by a tutor with IT competencies that can support him or her.

### 4.2.2 Familiarization and Personal Confidence Training:

One step towards making teachers feel comfortable with computers as a teaching tool is to train them in using computers as a personal tool. Each school should provide a place where teachers can work with computers to preview software, prepare materials, etc. (Langhorne, et al. 1989).

It is very important for the teachers to become familiar with the computers they are likely to use in their classrooms, and to be convinced that they it is worthwhile for some of their own work. Teachers can become confident by practising and using a number of software packages to confirm their basic training. This could include use of computers for personal work such as preparing lesson plans, maintaining students' records, reports, etc.. Successful personal use, should encourage them to use computers in the classroom.

Hoyles, et al. (1990), after evaluating their programme, concluded that an important requirement for using the computer in the classroom was the development of personal confidence and competence in using the software. They claimed:

> "The tendency was for those who started the course with an initial confidence in using computer applications to be more successful at integrating the computer into their practice." (p. 18)

It is not the improvement of skills, but a building of confidence brought about by such performance which can be of fundamentally importance to the individual teacher. Summers (1990b) pointed out that computer knowledge is important in one's social skills because they are prevalent in society and even young children use them confidently, but if someone feels they have passed him by, then perhaps a feeling of inadequacy develops. A sensitivity to the possible existence of these kinds of feeling is obviously important for the teachers and for teacher trainers.

### 4.2.3 Training in the Use of Computer Applications in the Classroom:

Research on teacher training indicates that only when teachers have become confident with computers, is it possible to train them in some computer applications in the classroom.

Teachers may then be trained to use some type of software packages in schools and to identify which software packages should be used to facilitate different types of classroom activity. They may also learn how to use computer applications as problem-solving tools, as teaching aids and for classroom management.

At this level, teachers should be encouraged to think of how to list considerations in the evaluation of educational computer software used in schools, and evaluate critically a specific piece of software.

### 4.2.4 Subject Training; Practical Training for Science Teachers:

While basic training is essential, there is also a need for special training for individual subjects. The purpose of the special training is to enable teachers to use computer applications in their own subjects in order to apply their previous training to their daily teaching. Otherwise they might not do so. In their follow-up study, one year after the training course, D'Arcy and Gardener (1986) reported that: because the in-service training was not translated directly into CAL practice in the classroom, only 41% of the respondents (n=91 of original 194) reported that they had used computers in their teaching.

Subject training for science teachers should illustrate some of the software packages useful for science. This would include examples at different levels and in different science subjects. Science teachers should be able to:

a) use computers in the science classroom effectively;

b) prepare science materials using different software packages;

c) train pupils to use computer applications in the science classroom and to produce their own work;

d) prepare pupils to simulate science experiments and data using computers.

e) evaluate a specific piece of software.

They should also be trained to research, trial, and produce a substantial science work using various computer software.

## 4.3 Influence of Teachers' Knowledge, Experience and Attitudes:

Research and other studies by Summers (1990) has shown that teachers' reactions to training in the use of computers is influenced by a complex series of interrelated factors, such as the teacher's knowledge, experience and attitudes.

After examining the reasons for the negative feelings of some PGCE students, Summers (1990a and b) found that lack of knowledge and experience were the main reasons for negative feelings about learning to use computers. Nearly all the students rated such knowledge as quite important or very important. He stressed that:

> "The evidence from this research is that negative feelings are associated significantly with lack of experience of computers. This is obviously an encouraging finding for teacher educators, since it suggests that what we do might make a difference!" (p. 87)

Similarly, Underwood and Underwood (1989) found that negative attitudes decrease teachers' use of computers, even when computer facilities are available in their schools. They also found that many of the Anti-computer teachers could develop more positive attitudes when they were given first-hand experience of the machine. Other research has demonstrated conclusively that practical training increases teachers' positive attitudes in using computers (see Hoyles, et al. 1989).

Summers concluded in his two surveys (1990a and b) that teachers' attitudes were significantly related to their use of computers in the classroom. These views are supported by Rhodes and Cox (1990), earlier work of Gardner and Megarity (1987), and a survey by DES (1989b).

Abdel-Gaid, et al. (1986) perceived teachers' attitudes toward computers as the central issue in computer use. They claimed:

> "Science educators can hardly ignore the trend toward the use of microcomputers in the teaching of science. And central to the success of this new initiative will probably be teacher attitude." (p. 824)

## 4.4 Teacher Training in Practice:

When providing INSET, many issues need to be recognized such as: training sources, place and time period, and funding. Gardner and Megarity (1987) listed and illustrated the sources of in-service courses in the UK, (see table 4.1)

| | Type of courses* | | | | | |
|---|---|---|---|---|---|---|
| | C | nC | FT | PT | LT | ST |
| Universities | + | | + | + | + | |
| Polytechnics | + | | + | + | + | |
| Colleges of Higher Education | + | | + | + | + | |
| Colleges of Further Education | + | | | + | | + |
| Teachers' Centres | | + | | + | | + |
| Local Authority Support Centres | | + | | + | | + |
| Schools | | + | | + | | + |

* C= Certificated, nC= non-Certificated, FT= Full-time, PT= Part-time, LT= Long-term, ST= Short-term.

Table 4.1 Sources of in-service teacher training.
(Source: Gardner and Megarity, 1987)

Table 4.1 indicates that there are three main sources of teacher training:

a) Universities, Polytechnics, etc.;

b) LEAs support, and

c) Schools.

Gander, et al. pointed out that at that time almost all pre-service training was run at Universities and Polytechnics, while in-service training was run at schools and Universities with the support of LEAs. More recently, this has been changed, as schools often preferred the flexibility of making their own arrangements. Therefore, Universities and LEAs have lost most of their responsibility for INSET. A survey by NFER (National Foundation for Educational Research in England and Wales) showed that the move towards school-based INSET had led a growing number of the higher education institutions to modify their provision, to become more flexible and to accredit classroom-based study (DES, 1990).

It is likely that provision of in-service training could be organised according to the levels described previously. The first two training levels (i.e. basic, familiarization and personal confidence) could be run by the schools for all teachers because they are more general, while the last special training levels (i.e. computer applications in the classroom and subject training) could be run as a support service of LEAs, for example by an advisory unit or by training institutions at Universities or by both.

School-based INSET activities, with teachers working alongside colleagues and advisory teachers, have become increasingly widespread (DES, 1990). Most teachers prefer to receive their training in their schools during the day. The teachers also prefer classroom-based training where much of the training can be practised inside their classrooms. Goler (1990) found that 63% of a sample of 50 primary school teachers preferred school-based INSET, while only 9% wished to attend evening courses. This indicates that teachers do not wish to give up their evening to attend INSET courses. Therefore, to ensure the success of teacher training programmes, these courses should be carried out in the schools and should be pupil oriented. This move in the pattern of INSET was supported by the report for the DES by Brown and Earley (1990):

> "The trend, as earlier noted, was for traditional course attendance models of INSET to be replaced by school-based models." (p. 32)

The training programme would be more successful if given in short periods. Hoyles, et al. (1989) and (1990) ran 30-day INSET courses. Although they spent half of the course in LOGO training and another half in all other computer applications, they claimed significant improvement in experience and use of computers, especially in computer applications. A DES report (1990) stated that the staff training days (Non-contact days usually at the start or end of school term) were "potentially, a very successful means of providing INSET for all staff which created no disruption to learning."

Teacher training has started to shift from training on computer languages to computer applications according to the teachers' real needs in the schools. Boyd-Barrett (1990) pointed out that we spend much time and a lot of money in training for BASIC or LOGO or whatever language and then complain of short training time and lack of use of computers by teachers. The training of teachers in computer languages started with the idea of using them in the subject teaching, but nowadays, there is little or no use for them in the classroom. Subject teachers use computers to aid their classroom teaching, therefore they should be trained to achieve this target.

It is necessary to make teachers, officials and perhaps some educators aware that we do not want teachers to be specialists in computers, but we do want them to use computers to assist their teaching.

Another basic issue influencing training is funding. For example, in the UK, the Task Group on Assessment and Training states that it would require over £20 million to provide only one day's INSET for every teacher

(Boyd-Barrett, 1990). Because the cost of taking a teacher out of the school is about £100 per a day, it would be much cheaper to train through school-based INSET on non-contact days.

## 4.5 Information Technology Across the Curriculum:

Because of changes in the patterns of the use and provision of computing facilities to microcomputers today over from Mainframe machines, policies have developed in the UK, USA and some other countries, for moving schools from Computer Studies Examinations for a minority of pupils toward Information Technology (IT) across the curriculum for all pupils. Computer studies might be a valuable subject for some pupils to study but its detail and approach are not essential for all pupils, who require an education in the broad concepts associated with IT (Allen, 1991).

The introduction of IT across the curriculum is built upon two perspectives: first, to deliver IT to all pupils. (Many educators take the view that IT is best delivered through other subjects (HMI, 1985).); second, to teach the elements of learning subjects, that is, knowledge, concepts, skills and attitudes to be developed (HMI, 1985).

National policies toward the role of IT in UK schools are seen as crucial to its use in education:

> "IT has a critical role in enhancing the learning process at all levels and across a broad range of activities including but going beyond the National Curriculum. Through the use of IT in the curriculum, schools will also be helping pupils become knowledgeable about the nature of information, comfortable with the new technology and able to exploit its potential." (DES 1989d, p. 2)

The IT approach in the UK has focused on using IT across the curriculum rather than introducing it as a specific subject, The DES (1989d) stated that all pupils should use a range of IT resources in core, other foundation and, where relevant, non foundation subject and cross-curricular themes.

The need for children to be given the opportunity to develop an IT capability, with the publication of the subject orders for technology, has now become a statutory requirement (DES, The Curriculum from 5 to 16). The shift of emphasis towards the integration of IT into the curriculum as a whole places demands on curriculum design, staff support and teacher training strategy. Allen (1991) stressed that "Unless there is more emphasis on teacher education in IT, then IT successfully delivered and used across the curriculum of secondary schools will continue to remain only a vision." (p. 23)

The new strategy of using IT across the whole school curriculum requires <u>all</u> subject teachers to use computers to deliver some of their daily lessons, every teacher, therefore should be able to use computers in his/her classroom successfully. This leads to the requirement of <u>compulsory</u> computer training for all school teachers. This must be the reason behind the demand that has been made by CATE for inclusion within ITT of compulsory teacher training in computer use for every school teacher (see section 4.1).

## 4.6 The Role of Computer Studies (IT) Teacher:

The shift in the pattern of use of computers in schools requires a new role for the Computer Studies teacher in schools.

Today, in many schools, the teacher of Computer Studies is the key figure in teacher training and computer activity in schools. He is the manager of computer resources including school network and software support. He has also to train his colleagues for preliminary levels (1 and 2), and to continue supporting them in their classrooms wherever they feel necessary. Additionally, he has to teach any IT course(s) that existed and co-ordinate computer activities in the school.

It seems that the Computer Studies teacher is the right person to run some of the training programmes, in order for teachers to be trained in a short time, economically, practically, and inside the schools. Obviously, no other person can do this.

## 4.7 The Needs for Pre-and In-service Training for Saudi Arabian Secondary School Science Teachers:

The previous sections have argued that successful pre-service training and INSET are a necessary precondition to the better use of computers by school teachers. It is also apparent that the quality and effectiveness of training programmes depend on the knowledge, experience, and attitudes of both teachers and trainers.

Science teachers can not be successfully trained to use computers unless they have positive attitudes towards such training. Because the best place for training is within the schools, it may not be possible to provide the necessary training without the cooperation of the computer studies teachers. But preservice training and INSET require the teacher educators to have the necessary background, skills and attitudes to engage in such training.

The introduction of computers into Saudi Arabian secondary school science teaching requires basic measuring of science teachers' and educators' background, knowledge and attitudes toward the use of the computers in science teaching. Computer provisions and facilities provided in the schools are also important. Initial measurements of attitudes as well as a survey of provision possibilities are addressed in the next chapter in the context of the preliminary field work.

INSET courses are important, that is they have to be taken into account before introducing computers into science classrooms. However, the last section has indicated the important role that can be played by the Computer Studies teacher. Thus, another target for the preliminary study was obtain preliminary data for later study of the possibility of science teachers being trained by their computer studies colleagues.

# CHAPTER 5 : :

# THE PRELIMINARY FIELD STUDY

## PART A :

### 5.1 Aim of the Study:

The main purpose of the thesis is to consider some of the problems that may arise when computers are introduced into Saudi Arabian secondary schools and used to aid science teaching.

During March and April 1991, a preliminary study in Saudi Arabia was carried out to confirm the structure and scope of the main field work (to be discussed later in Chapters 7 to 10). The function of the preliminary field study was to investigate the possible content of:

. a self-completed questionnaire for secondary school science teachers (ST);

. a survey of computer facilities currently available in the secondary schools.

. a structured interview schedule for use with science teacher trainers (STT) and others responsible for the improvement of science teaching;

. a structured interview schedule for use with the officials in the Ministry of Education who are responsible for schools policy.

## 5.2 Content of the Interviews:

For the majority of the field work, three semi-structured interview schedules were developed from the previous literature in the field and were used with three types of samples throughout the period of the study.

The topics covered by the STs' and science teacher advisors' (STAs) interviews were: teacher knowledge about computers; previous teacher training and experience in computers; teacher attitudes to the use of computers to aid science teaching and their introduction into the science classroom; teacher attitudes toward computers in education and generally.

Main objective of gathering data from computer studies teachers (CSTs) was to survey computer facilities which could be used to aid science teaching.

STTs were interviewed under the headings of: knowledge about CAL; attitude towards CAL and attitudes towards the introduction of computers to aid science teaching in secondary school. They were also asked to give their comments about the contents of the three interview schedules.

Before the interviews were carried out, draft interview schedules were trialled with one ST, one STT and one CST. Results of these trials suggested that some questions should be deleted, others combined, and the order of some questions changed.

A copy of each interview schedule as used in the preliminary study is attached in Appendix C.

## 5.3 Methodology:

### 5.3.1 Method of Collecting Data:

Data were collected in person, by letter and by telephone conversations. All of the interviews followed a semi-structured format which was adapted from time to time according to the responses of previous interviewees. Also, during the interviews the discussion was directed towards specific areas of the study relevant to the knowledge and experience of the interviewee. For this reason, some interviews covered all topics, while others did not.

There were telephone conversations with three teachers in Riyadh city following the main procedure of the original schedule. Interview sheets were also given to three teachers in Madinah city, who were requested to write their responses.

The time spent on each personal interview was from 20 minutes to two and a half hours, while the telephone conversations took 10 to 30 minutes. The interviewer recorded responses using a structured response sheet and tape.

### 5.3.2 The Sample:

The samples were chosen by the interviewer as convenient to visit and available for discussion. They were chosen from three main cities in Saudi Arabia with different LEAs: Riyadh, Jeddah, and Madinah. Three types of sample were included: science teachers, computer studies teachers, and science trainers as follows (Table 5.1):

a) 17 STs: 1 from Riyadh and 16 from Madinah including 1 in a private school , 2 vice-headmasters (VHs) who were STs.

b) 7 CSTs: 1 from Jeddah, 4 from Madinah including 1 in a private school, and 2 from Riyadh including 1 computer studies advisor involved in computer curriculum development at the Ministry of Education.

c) 3 STTs from the college of Education in Madinah.

| Group | Occupation | Riyadh | Jeddah | Madinah | Total |
|---|---|---|---|---|---|
| ST | ST | 1 | - | 13 | 17 |
| | Private ST | | | 1 | |
| | VH was ST | | | 2 | |
| CST | CST | 1 | 1 | 3 | 7 |
| | Private CST | | | 1 | |
| | CST & CSTA | 1 | | | |
| STT | STT | - | - | 3 | 3 |

Table 5.1 Description of the sample by location

### 5.3.3 Limitations:

The nature of this study did not require specific randomization of the sample, so the sample was chosen from a wide range of persons likely to have useful information and who were available for interview. For this reason, the findings are merely indicative of the scope of school facilities and respondents' qualifications.

## 5.4 Findings:

The data collected from 17 STs, 7 CSTs and 3 STTs were scanned and analysed. Two types of findings were drawn up from the data: general findings related to computer facilities existing in schools and general understanding of the subject on the part of the sample, and special findings related to the qualifications, characteristics, and attitudes of the samples.

### 5.4.1 General Findings:

The excellent computer hardware available in the Saudi Arabian market has not yet been installed in the schools. Currently, there is a shortage of computer software in the schools. However, there are slight differences in the availability of computer facilities among Saudi Arabian cities, in favour of the larger cities.

The general understanding of computer uses in schools is confined to learning about computers only. There is no knowledge or idea of learning or teaching with computers. Moreover, the general understanding of teaching about computers is that it is confined to learning about computer programming.

The ST sample did not distinguish between using computers in schools and using computers in the science classroom. Therefore, after six interviews, it was decided to combine the two sections in the interview schedule to be used as one section, and this was used with the remaining subjects.

### 5.4.2 Special Findings:

#### 5.4.2.1 Qualifications:

The majority of the ST sample (11 of 17) had BEd; the others had BSc. In addition, some of them (six out of 17) had a higher qualification such as a Diploma or a Masters degree.

The majority of the CST sample (6 out of 7) had no teaching qualifications, though one had a teaching methods background. This teacher had qualified at King Sauod University in Riyadh, where there is a new computer department in the College of Education.

All three STTs selected had attended some computer courses, one had written an article related to computers, none of them had done research related to computers or their use in education.

#### 5.4.2.2 Characteristics:

Although about half of ST sample (eight from 17) had a personal computer, their computer experience was not extensive. They used these PCs for typing and games only. Some of them (four out of 17) did not know even how to turn a computer on and off, while only a few (three from 17) had any awareness about using computers to aid teaching. However, some of them could recognize some Microtext software which was produced by Al-alamiah computer company. Table 5.2 shows the main computer uses in science classrooms as perceived by the ST sample.

Table 5.2 indicates that the majority of the sample believe that the objective of introducing computers to science classrooms is for tasks like audio-visuals or writing examinations.

| Computer uses in the classroom | Number of responses |
|---|---|
| Audio-visual | 9 |
| Writing examinations | 7 |
| Saving lesson plans | 4 |
| Alternative to the science laboratory | 3 |
| Games | 3 |
| Tutorial | 3 |
| Solve mathematical exercises | 2 |
| Programmed learning | 2 |
| Graphs | 2 |
| Saving curriculum text | 2 |
| Nothing (no idea) | 4 |

Table 5.2 Science teacher sample responses to possible computer uses in the classroom

The responses of STT sample indicated little knowledge and experience of using computers to aid science teaching.

No training courses had been held for either STs or STTs. However, some teachers and trainers had received some computer training concerning general computer literacy and programming. Such courses are normally run by private i.e non-LEA companies.

#### 5.4.2.3 Attitudes:

Almost all of the ST sample claimed that they needed computers to help them in the classroom, but they did not know exactly how it would help. They indicated absolute conviction of its advantage in science teaching. They also showed positive attitudes toward computers' roles in society.

A few (two from 17) STs read computer articles. Meanwhile most of the sample (12 from 17) claimed shortages of resources.

Sixteen STs agreed it would be useful to introduce computers into science teaching, although they anticipated various problems, as shown in Table 5.3.

| **Possible problems** | **Total (from 17)** |
|---|---|
| Software problems | 7 |
| Difficulties with the pupils | 6 |
| Economic problems | 6 |
| Training problems | 5 |
| Difficulties with the teachers | 4 |
| Machine service problems | 4 |
| It doesn't do the experiments | 2 |
| Hardware problem | 2 |

Table 5.3 Science teacher sample responses to possible problems linked to the introduction of computers into science teaching

The STTs reported that they included some theoretical lectures about computers in the science trainees' initial training programme. One of them mentioned that he had written a theoretical article on the use of computers for science teaching. The article was not based on classroom practices.

When the three STTs were questioned about their attitudes toward the use of computers to aid science teaching, all showed positive attitudes and agreed that it was necessary to introduce computers into secondary school science classrooms. However, they stipulated some conditions for the introduction such as: a comprehensive training programme for all people involved in science teaching, adequate consideration of software, providing clear objectives for the introduction and preparing the schools.

#### 5.4.2.4 Factual Information:

In each secondary school there is: a computer room, a CST and 16 microcomputers, type MSX 350.

Every secondary school pupil should have three computer courses in Management and Social Studies stream, or two computer courses in the other three streams. The courses are: Introduction to Computers, Introduction to Programming (BASIC language) and Computer Programming & Introduction to Information Systems.

The interviews revealed meetings between CSTs and their science teacher colleagues which aimed at improving teaching, although some CSTs claimed that they had tried unsuccessfully to hold some courses for school teachers.

Although no problems related to computer hardware were mentioned by CSTs, they claimed that there were problems such as lack of computer books, suitable room and teacher advisor.

## 5.5 Conclusion:

The study has showed that although the ST sample had no basic knowledge about computers, they had favourable attitudes toward using them in their teaching. Therefore, appropriate experience would be likely to encourage them to use computers in their teaching.

The interviews indicated the absence of teacher training in the use of computers. None of the ST sample had computer training and only one of the CSTs had any training in teaching methods.

The survey has showed the shortage of CAL software in relation to the expansion in computer hardware. Two difficulties would explain this shortage: first, software language, because most of the commercial software is written in English; second, shortage of specialists who can establish a specific-use of educational software, the CAL. On the other hand, an open market like Saudi Arabia with low taxes makes it worthwhile for computer companies to import a wide range of high standard computer hardware.

## PART B:

## IMPLICATIONS OF THE PRELIMINARY FIELDWORK FINDINGS

The following points can be drawn from the preliminary field study findings:

- strong positive attitudes among both teachers and educators, toward the introduction of computers into science teaching;
- insufficient computer background among STs and other educators;
- shortcomings of computer training: nature, extent, and numbers;
- shortage of CAL software, in contrast to a wide range of computer hardware and business software in the market;
- limited number of computer studies teachers in the school who have both computer qualifications and teaching method qualifications.

The following sections highlight these issues.

### 5.6 Insufficient Computer Background:

The science sample lacked computer knowledge generally and specific computer knowledge such as knowledge about the benefits that computers bring to schools. Some teachers expressed regret that their students had more computer experience than they did. "*I have an uncontrollable feeling when some of my students ask me things about computers which I do not know*" one science teacher said. Another teacher did not know the meaning of "programming", a third did not know how to turn the computer on or off. Some doubted whether there is a relationship between computers and science teaching. (Summers (1990) examined computer knowledge of 57 teachers and found that 30% of the sample had negative feelings about computers because of lack of knowledge and experience.)

The teachers had no chance to train inside their schools because most computer courses were run outside schools.

There is general misunderstanding of CAL and the aims of introducing computers to aid science teaching, as the majority of the sample interviewed did not distinguish between learning about computers and learning with computers. Therefore, the main study will take into account the sample's limited background and misunderstanding and will avoid terms like CAL, CBL, etc.

### 5.7 Shortage of Computer Education Specialists in Schools:

Each secondary school in Saudi Arabia has only one CST. A small number of these are qualified teachers, the majority are engineers or computer specialists. CSTs reported their need for more teachers to help them in the computer room. The preliminary study showed shortages of computer specialists in Saudi Arabia generally, and most of them prefer to carry on in their subject or to work in the industrial sector rather than to teach in schools.

The absence of computer teachers' training in teacher training colleges and educational institutes made it necessary for the Ministry of Education to look for computer engineers and specialists to teach computer studies courses on a temporaray basis. The only institute which has recently provided training on computers as well as teaching methods is the College of Education at King Saud University.

## 5.8 Shortcomings of Computer Training:

Because of STs' lack of computer experience and their urgent need for computer training, plans should be made for their training. However, before that is done, the type of training needed should be considered. Training should be aimed at giving STs appropriate experience to use computers in their classrooms.

Teachers will not be required to know how computers work, or how programs can be produced, but how computers can be used, in their teaching, just as a person can drive a car without knowing how it works.

Mindura (no date) carried out a computing training project to be used for Arab subject teachers. He suggested that computer colleges and institutes could run the programme, and suggested the following content for the programme:

a) Introduction to computer science and programming (1);

b) Introduction to computer science and programming (2);

c) Computers and learning;

d) Processing and microcomputers;

e) CAL;

f) Microcomputer applications.

The programme requires four full terms, but Mindura gave no indication of the programmes financial cost, or how much the Ministry of Education would need to spend to cover for teachers who will be away from their schools for two years. This programme is comprehensive, and teachers who attended the programme would learn to teach computer studies courses, not just to use computers as a subject aid. However, the programme is not practical, because the Ministry of Education which previously provided only a few short INSET courses, would not accept a two-year course. Another problem is that the teachers do not need training on programming, because they are not going to teach computer programming, but they need to use computers to assist their teaching.

A practical training programme might be held inside the schools, in a simple and economic way. This would very likely be accepted by officials and teachers as well. The training programme should take into account teachers' personal benefit, as well as their real needs in the classroom.

Some CSTs have indicated their willingness to train their science teacher colleagues. In this case, training courses could be held inside schools for minimum cost. CSTs are already teaching school pupils the computer studies courses 1, 2, 3; therefore, they could give extra courses for their science teacher colleagues. More investigation of this possibility is carried out in the main fieldwork.

The fieldwork findings (Chapter 10) will give further details about the willingness of CSTs to take part in the training of their science teacher colleagues.

## 5.9 Will Computer Studies Teachers Share with Their Science Colleagues?:

The preliminary study indicated a lack of training in teaching methods among CSTs, and a lack of computer literacy among STs. This supports the idea that it might be appropriate for CSTs to share computer provision with their science colleagues in the schools. The sharing could achieve the following objectives:

- The sharing would allow CSTs to train their science teaching colleagues on computer use inside schools. This would be more acceptable for science teachers.
- Science teachers could obtain benefits such as computer awareness and confidence as well as being assisted in their science teaching.
- It would save money and time. Science teachers could use the same machine and the same computer room as CSTs use.
- STs could train their computer studies colleagues in methods of teaching. Therefore, there would be no need for INSET courses outside schools in teaching methods for CSTs.

School-based sharing between CSTs and subject teachers exists and has been successful in the secondary schools of some industrial countries such as UK and USA (see section 4.6 in Chapters 4). Therefore it would be worthwhile for Saudi Arabian secondary schools to start by sharing between CSTs and STs. If this succeeded, the sharing could be extended to other subject teachers.

## 5.10 Computer Machines:

The preliminary study showed that the number of computer machines in each Saudi Arabia secondary school is about 16 computers, type MSX 350. This type is similar to the BBC machines in the UK, which are not a standard type and therefore need a special type of software compatible with these machines only. The schools lack common types of machines which are normally low-cost and easy to use.

The compatibility of school computers with those readily available on the market would make a wide range of both hardware and software available. The cost of commercial types is more economic in the Saudi Arabian market. For both reasons the use in schools of standard types such as IBM and its compatibles, or Apple Macintosh, would be more practical for both students and teachers. One objective of the main fieldwork is to investigate the policy of the Ministry of Education regarding computer provision.

## 5.11 Shortage of CAL Software:

The only CAL software available in the Saudi Arabian market is a small range of Microtext programs produced by Al-alamiah computer company for different subject curricula, such as science, mathematics, geography etc. This type of CAL simply transfers text from books to the screen (see Microtext in Chapter 2). The programs do not provide any assistance or encouragement to the user. Some pictures which already existed in the books are provided. At the end of each program, the user is asked to answer some questions, usually similar to those in the text books. If the student answers a question correctly, then the computer asks him another question, but if he does not, the computer then gives some extra explanations, until the pupil gets the correct answer.

Little benefit can be gained from Al-alamiah software, yet it costs about 500 S.Riyals (£80), while the cost of some business software is around 250 S.Riyals (£40). The high price of Al-alamiah software reflects the lack of CAL software in the Saudi Arabian market.

Although a few parents have bought these programs for their children, the majority of students have no opportunity to use or even see them. There was also little knowledge about them among the ST sample, although half of them had personal computers.

In any case no significant aid to science teaching is being provided by this kind of software, as it is too inflexible. Each program is produced for a specific topic only, which could be one reason for their high price, they need sensitive work and materials to cover a small subject area. Moreover, this type of CAL has minimal interaction between the computer and the learner.

Could alternative software be used? The Saudi Arabian market has a wide range of general computer applications which are used for business purposes. These types of software can be used in different languages including Arabic; they are available at economical prices, they are easy to learn and use as is shown in the next chapter. But the question is, can such software be used to aid Saudi Arabian science teaching?.

# CHAPTER 6 : :

# GENERIC SOFTWARE AND ITS USE FOR SCIENCE TEACHING

## 6.1 Introduction:

Chapter 3 has indicated some problems of using CAL for science teaching, such as high price, low quality and little benefit. The preliminary study has suggested there are further problems with the use of CAL in Saudi Arabian science teaching that are related to the language. Because each CAL program is produced for a specific subject, it is impossible to use it with another, especially in a different language, therefore, because most CAL software is not in Arabic, little or no CAL could be found for use in Saudi Arabia in the short term.

In addition, the preliminary study has shown the lack of computer knowledge and experience of science teachers and educators. Therefore, an extra difficulty in using CAL could arise here.

In recent years, educators concerned with computers in schools have argued the great benefits of introducing the types of software which the business and industrial sectors use. (See for example McLeod & Hunter, 1987; Troutner, 1988; Elliott, 1992; Beare, 1992; Turner, 1992.). Generic (business) applications are the types of computer software which are originally produced for non-specific content; these are free "tool-kits" for whatever content can be put in. Consequently, they can be used as a tool for several topics and subjects for various business and education purposes.

Generic computer applications are rapidly being launched into schools in countries such as UK and USA. Recent studies in the field of computers in science teaching indicate successful integration of these types of software into the science curriculum. Advantages such as low price, high quality, relevance to the pupils' future needs, simplicity of use for both teachers and students, ready availability, and so on, have given further impetus to the use of these types of software in the science classroom.

Databases (DB), spreadsheets (SS), and wordprocessors (WP) are the most popular generic software in the commercial market. All of them have been used for subject teaching. Databases and spreadsheets are used widely in science teaching today.

Using DB and SS for science teaching in SA would solve many, perhaps most, of the software problems because a wide range of these types of software already exists in the Saudi market, with Arabic language or Arabic support. Digranes and Digranes (1989) stated that:

> "Locating instructional materials specifically designed for various cultural groups is difficult because such materials are typically limited or non-existent. The teacher's options are to create new instructional materials or to adapt other available materials to the special cultural needs. Creating new instructional materials is a labor and time-intensive process. Teachers will often choose to adapt existing instructional materials. Computer software applications, such as wordprocessing, databases, and graphics programs, are commercially available instructional material that can be easily adapted by teachers to meet special cultural needs." (p. 20)

Another advantage of using these applications is that little training for the teachers will be required; the preliminary study shows some STs already use them. "*I use my PC for typing and organizing my personal library; it is easy for me to do this*", one ST mentioned during interview. Therefore, a short training period should suffice, which would be pleasing to both science teachers and the Ministry of Education.

In all types of generic software applications, computers can make an important contribution to enabling students to become active learners through open-ended investigations and problem-oriented questions. This can encourage them to formulate actively and try out their own ideas, rather than simply follow a <u>list of instructions as to what to do</u> (Beare, 1992). This method of teaching fits in with a constructivist view in which students are seen as actively constructing meaning and understanding for themselves, rather than receiving it passively from teachers and textbooks.

This chapter reviews some literature concerning generic software in teaching and presents examples and ideas about its use in science classrooms. It examine databases and spreadsheets, each application being followed by illustrative examples of its use for science teaching.

Because a wordprocessor is not specific to science, but it is also suitable for other subjects as well, only a brief description of the use of WP is presented later in this chapter.

At the end of the chapter, electronic mail and datalogging are briefly discussed as examples of other generic software which are up to the present less relevant and less commonly used in science classrooms.

# PART A: DATABASE

## 6.2 What is a Database?:

A database system is a way of storing data and keeping track of related items which makes it easy to recall, investigate, add to, amend and sort the stored data. If the system is based on a computer it usually means that large quantities of information can be handled accurately, relatively quickly and without fatigue. A Computer-store of information can also be cleared and refilled very rapidly with completely new information. A database is simply a medium for collecting together quantities of data in a form where they can be retrieved, searched and ordered with ease.

A database is divided into records. For example, each card in the personal phone directory is a record, and each record contains various kinds of data (names), area codes, numbers, street addresses, etc. These categories are called fields. When one writes a particular name (Sarah) or area code (0482) in the record, he is putting an entry into the field.

Daines (1984) has suggested nine operations for manipulating data:

. data capture-obtaining the data,

. data input-entering it into the system,

. organisation-sorting data efficiently,

- storage-retaining the data,
- search-finding desired items,
- manipulation-adding totals, comparing, etc,
- retrieval-bringing the data out,
- presentation-making it meaningful,
- evaluation-applying standards.

A database is a shared collection of interrelated data designed to meet the needs of multiple types of end users (Martin, 1981). Either textual or numerical data can be used. A simple way to represent data is in two-dimensional tabular form. The tabular form is a logical structure for the user which is different from the way the data are actually stored. Various commands are used to create the file, insert and delete, edit, retrieve, search and arrange information, change the layout, and make a report which can be printed or inserted into a wordprocessed article (Brown, 1987).

Databases are normally designed to be expandable and to be as flexible as possible, containing words and clues as well as words together with a classification group; therefore they consist of two sections: the actual information and the various classifications.

### 6.3 Using Databases in Teaching:

The ability of a database to organize and retrieve information quickly according to many criteria, which its user can modify at will, is a powerful tool with which students should become familiar -as part of their computer literacy- as early as possible (McLeod & Hunter, 1987).

The computer can bring a new dimension to the teaching of a variety of subjects by acting as a resource, offering almost instant access to information. This raises questions about the ability of pupils to cope with information and the need to learn about information handling on a personal basis. It is quite possible to collect information for the sake of collecting it, to refine the access procedures until they become an esoteric art form and to concentrate on individual items to the exclusion of the whole. In schools, students are usually dealing with relatively small amounts of data, but the skills of handling these data could be given to the learner naturally through learning some basic database procedures.

The increasing use of information-handling software, both inside and outside schools, is creating a growing demand for more highly developed information-handling skills than have been generally encouraged in the past. For instance, "Use your periodic-table to find out ... and then complete the following paragraph." These skills could be developed through the use of computer databases if the children are encouraged to ask themselves a set of questions, investigate, conduct some research or solve a problem and consider the part that the computer might play (Straker, 1989).

As students become familiar with databases, they could add information to the base from their own experience. They could determine what question they want to ask, what data they need to answer it, and how they should best organize that data (McLeod & Hunter, 1987).

Acquiring problem-solving skills continues to be an important part of the general goals of education. Some educators have chosen to direct some of their curriculum-development efforts toward teaching inquiry skills as part of problem-solving skills within their subject domain. Berge (1990) emphasized that using a computerized database is one possible helpful approach in teaching these skills successfully. Unlike topic-specific CAL, databases being content free can be used as a tool for a variety of problem-solving activities rather than presenting specific material or information. Newell (1980) argued that the problem solver first constructs a plan in some abstract or simplified "problem space" and then uses that plan to guide the solution to the problem.

The interactive nature of computer learning often allows students to discover quickly whether or not their plans work. The computer need not be viewed as a discipline (i.e. computer science and programming), but as a tool for encouraging activities and skills already stressed in the established subject area. (This concept of using the computer as a tool to promote inquiry skills is already stressed in subject learning.)

Sartor (1985) argues the development of critical thinking skills in creating and working with databases, while Little (1985) suggests that students start with generalization and determine what information they need to give an informed opinion. Then, students gather the data and use them to see if the generalizations apply. When they are working with a sample of the population, students should be encouraged to make inferences from the data.

One of the most difficult tasks in planning a database is to understand the data needed by the users and to be prepared for increased use of the database as users realize its potential. There should be a high degree of sharing of data so that they are used in multiple applications[1]. In designing a database one collects the data requirements and creates a logical model of the data, taking into consideration the requirements of the "ready-to-use" software. Users should have to know as little as possible to get started and to use the database. Users should not need to know how a database works, but only how to use it (Brown, 1987).

Brown (1987) and McLeod & Hunter (1987) argue that when students ask the computer to produce the data in various configurations, they are like a research scientist organizing the results of experiments to test hypotheses. They emphasize that using databases in the classroom places students in the position of the research scientist with many assistants. Scientists formulate hypotheses on the basis of prior knowledge. Then they plan and conduct experiments to gather relevant data that can help to confirm or reject their hypotheses. Sometimes they need to consider their information many times in order to be sure they have the right answer. And sometimes, they find an unacceptable answer, or none at all, as a result of which they modify their assumptions. This is exactly what happens to the students when they use a database in the classroom, and of course, there is no doubt that these activities are important in modern teaching.

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1. Such as Electronic Mail presented later in this chapter.

Many studies have shown the success with which database can be used in teaching various subjects. Freeman and Tagg (1985) summarized the background to the development of the QUEST 'family' of programs and demonstrated the way they can be used in teaching of History and Geography. They also made comparisons with other database programs.

They concluded that the user (pupil or teacher) is in charge, not the computer and that MicroQUERY and QUEST are powerful pieces of software. They emphasized that a database is a 'powerful vehicle'.

Another review of the QUEST database was carried out by Smart (1988) who has reported on five QUEST projects studied during 1985-86: All About me; Our Weather; Our Food; Our Street and The World Cup.

The review indicated that the database acted as a catalyst, encouraging and actively promoting a wide range of learning situations that might not otherwise have occurred.

Knight and Timmins (1986) studied the use of several database programs currently used in classroom teaching. The study included: FACTFILE; QUEST; QUARRY BANK 1851 and B BASIC. They found them extremely useful in teaching the process of historical enquiry such as the cognitive skills associated with 'evidence handling' and social skills relating to small group work. They reported also that a database can help children to hypothesize about historical situations or events.

Low and his colleagues (1988) have shown the feasibility of a shared database of instructional strategies and support materials. They stated that there are two main advantages to using them in the classroom: first, for teachers, databases can aid teaching effectiveness, and they can save time; second, databases can easily bring many pieces of information relevant to teaching particular topics into one place.

Three reasons for using databases in subject teaching were seen by Langhorne and his colleagues (1989). First, they teach students' data-manipulation skills which are vital in the "information age", because today's students are entering into a technology-driven, information-rich society, where skill at using technology to access information is essential. Second, such a system provides a means for teaching higher-order thinking skills like classifying, comparing, contrasting, drawing inferences, hypothesizing, generalizing, and using Boolean logic. Third, databases can serve as an instructional vehicle for imparting a specific content. In any given curriculum area, in any particular content, the classroom teacher is faced with selecting an appropriate method for putting the content across to the students in the way which will most effectively and efficiently bring the student to attainment of the lesson objectives, database can assist.

## 6.4 Examples of Database use for Science:

Science teaching is well suited to the use of database software, since it emphasizes solving and inductive reasoning within a subject domain. Databases promote inquiry and thinking skills which receive a great deal of attention and are emphasized as being at the heart of science education (Berge, 1990).

Although databases have only recently been integrated into the science curriculum, the flexibility of such software has given rise to a rapid increase in educational packages concerning science subjects. The following sections give some examples of database packages that are or have been used for science teaching in the secondary school. QUEST and BP are an early examples of generic software to aid science teaching. QUEST has non-menu drive command. The BP Energy File shows the limited freedom on the part of the user in an early database application for science teaching.

### 6.4.1 QUEST:

QUEST is an information handling package. It enables the user to manipulate quickly and easily a large amount of information. The user can organise information, change it, add to it or ask questions, and display the data in text and graphics on both screen and printer. The user can choose what he wants without having to adhere to a pre-set structure of responses required by the computer.

Three sample databases are included on the QUEST distribution disk:

. PTABLE: containing information about some of the properties of the elements of the periodic table. There is a record for each element.

. HAMLET: containing one record for each line in the first act of Shakespeare's famous play.

. TENNIS: an administrative database containing information about some of the members of the fictitious Hatfield and District Tennis club. There is a record for each club member.

QUEST has commands available to show on the screen. If the user types:

*COMMANDS*, he will see (Figure 6.1):

| | | |
|---|---|---|
| COMMANDS | | |
| =============== | ================= | |
| GO | INFILE | PRINT |
| QUERY | RESET | VALUES |
| HELP | EXPLAIN | OUTFILE |
| COMMANDS | FORMAT | EDIT |
| ARCHIVE | SORT | EXACT |
| JUSTIFY | SCREEN | SPRINTER |
| CONTINUE | CATALOGUE | KEY |
| HEADING | MEMORY | DELETE |
| TRANSFER | USE | FINISH |
| :_ | | |

Figure 6.1 QUEST main commands

PTABLE is an example of the use of QUEST in the science curriculum. To start QUEST, the user types: ***QUEST***

Before searching a database, it is essential to select which database is to be used. The command INFILE is used to select a database, followed by the name of the database required. Therefore, the user would next type: ***INFILE PTABLE***

The display changes to show a summary of the database called the VALUES screen (Figure 6.2).

```
 VALUES                                  Fields  [press <ESC> to swap]
========================               ==========================
Infile:   PTABLE                       NUMBER ELEMENT  SYMBOL  MASS
Outfile:  Con:
                                       DATA   DISCOVER ENERGY  GROUP
Records:  92     (Max: 192 )
Fields:   16     Exact: NO             MELT   BOIL     DENSITY SHELL

Go:      Max     Search: 80
Space: 65536     Format: 2

Fields in memory:

Query:

Print:
======================                 ========================
:
```

Figure 6.2 VALUES screen after infiling the database PTABLE

In order to look at the complete content of each record, it is necessary to type:

*PRINT ALL*

which tells QUEST to display all the information about the element(s). By typing: *GO 1*, it is possible to display full information about element number 1 (Figure 6.3):

The GO command starts the search while the number following GO tells the computer how many records to display. In the previous case only one record is requested, thus only one is shown. The user will then see:

```
NUMBER         1
ELEMENT        Hydrogen
SYMBOL         H
MASS           1.00797
VALENCY        1
OTHERV
PERIOD         1
GROUP          1
FORM           5
MELT           -259.19
BOIL           -252.7
DENSITY        0.00008375
-------------  ----------
-              -

Continue (Y/N)
```

Figure 6.3 Full information about the element number 1

Continue (y/n)?, press *Y* to see another record, but if the user presses *N*, the search will be interrupted. The screen display will indicate the number of records reading, for example:

** Interrupted **

3 record searched

1 record matched

To return to the screen, the user should type:

***VALUES***

Type: ***QUERY VALENCY EQ 3***, This means:

| | |
|---|---|
| QUERY | Ask QUEST to select all records for elements which ... |
| VALENCY | ... have a valency ... |
| EQ | ... equal to ... |
| 3 | ... the number 3. |

To start the search, the user should type: ***GO***

And QUEST responds with:
Counting ...
92 records searched
18 records matched

This means that QUEST has searched through all 92 records and that 18 of them satisfied the condition specified by the QUERY. Nothing was displayed because the PRINT command had not been used.

To select the names of the elements for display, type:

***PRINT ELEMENT*** (ELEMENT is the name of field required; it is not ELEMENTS).

Next, he types: ***GO 8***

The QUERY is still as it was last defined, so the user will see the list of elements which have a valency of 3, eight at a time on the screen (Figure 6.4)

```
ELEMENT:Boron
---------------------------------------
ELEMENT:Aluminum
---------------------------------------
ELEMENT: Scandium
---------------------------------------
ELEMENT:Chromium
---------------------------------------
ELEMENT:Iron
---------------------------------------
ELEMENT:Gallium
---------------------------------------
ELEMENT:Arsenic
---------------------------------------
ELEMENT:Yttrium
---------------------------------------
Continue(Y/N)?_
```

Figure 6.4 The first eight elements with a valency of 3

A simple QUEST database has four parts: QUERY, <fieldname>, <relationship>, and<value>. e.g. QUERY, VALENCY, EQ, 3.

Any field can be selected and a number of different <relationship> codes are allowed. There are two types of codes: numeric and string. Here are some of them:

. numeric relationships such as: EQ= Equals, GT= Greater than, LT= less than.

. string relationships such as: IDENT= Identical to, SUB= contains the sub-string (i.e. the sequence of characters).

To find elements with a valency equal to 3, or less than 3, or greater than 3, the user should type:

*QUERY VALENCY EQ 3*, or
*QUERY VALENCY LT 3*, or
*QUERY VALENCY GT 3.*

The value following a numerical relationship will be a number (see examples above), while the value following a string relationship can be any group of characters, which must be enclosed in double quotation marks.

To find the names of all elements known since ancient time, the user then types:

*QUERY DISCOVER IDENT "ANCIENT"*
*PRINT NUMBER ELEMENT SYMBOL*
*GO 13*

The ancient elements are shown on the screen which finishes like this: (Figure 6.5):

```
---------------------------------------
NUMBER :6
ELEMENT:Carbon
SYMBOL :C
---------------------------------------
NUMBER :16
ELEMENT:Sulphur
SYMBOL :S
---------------------------------------
.
.
.
NUMBER :80
ELEMENT:Murcury
SYMBOL:Hg
---------------------------------------
NUMBER :82
ELEMENT:Lead
SYMBOL :Pb
---------------------------------------

             92 records searched
             10 record matched
:_
```

Figure 6.5 Some 'ancient' elements

The relationship SUB allows a search for a sub-string. For example, to find the elements with the letter "s" in their SYMBOL field, the user types:

*QUERY SYMBOL SUB "S"*
*GO 3*

Although all this information about PTABLE exists in the database, it is also possible to edit more in the print statements, or to edit an existing QUEST database by using the command, *EDIT*. It is also possible to delete unwanted files to make room for data to be saved, by using the command, *DELETE*.

On finishing working, one leaves QUEST by typing *FINISH*.

## 6.4.2 The BP Energy File (BPEF):

This pack is published by British Petroleum (BP) Educational Service. It is a small database intended specifically for use in teaching. It uses energy data from the BP Statistical Review of World Energy, and national income and population data from the UN Statistical Yearbook. The pack includeds: Tutor's Guide; Program Notes; some Worksheets (Forecasting, student worksheets, maps) and a floppy disk.

The BPEF has 5 main curriculum areas of use:

1. Economics and Business studies;
2. Geography;
3. Computing: Use for useful, inter-disciplinary and confidence-building student projects and analysing what a data-base is and does.
4. Science: Use as a resource for Physics and Chemistry syllabuses at both GCSE and A levels,
5. Environmental Science: Use as a resource for investigation patterns of use of energy both by source (e.g. Nuclear and Hydro) and by consumption per head and per unit of national income.

To start the program, the user types:

*BP*, then by pressing <space bar>. He will see:

```
        B   P      Educational Serves
                    THE ENERGY FILE
                       by
            Ken Randall and Alen Haweley
--------------------------------------------------
Options:        1  Check the data available
                2  Table/graph data
                3  Try to forecast
                4  Explain these options
                0  Exit
--------------------------------------------------
Please type a number (0-4)
```

Figure 6.6 The main menu of the BP database

There are four different choices for the user, and he can exit from the program any time, wherever he wants, by typing *0*.

If he types *1*, then he will see:

```
                The BP Energy File
Data FILES are of two kinds:              Comparisons
  Time Series                             (1988 values)
  (1964-1988)
1 Oil Used          10 Oil Prod               14 Oil Res
2 Gas Used          11 Gas Prod               15 Gas Res
3 Coal Use          12 Coal Prod              16 Coal Res
4 HydroUse          13 T En Prod              17 Oil Prod
5 Nucl Use                                    18 Gas Prod
6 T En Use                                    19 Coal Prod
7 Pop Use                                     20 Oil Used
8 G D P                                       21 Oil Ex
9 RefinCap                                    22 Oil Im
                                              23 Gasolin
--------------------------------------------------------------
Type : 1-23 for file datails
            0 to return to the main menu_
```

Figure 6.7 BP options

If the user chooses one of the first kind (time series), the computer will disply four options:

1. one file as a TABLE;
2. one file as a GRAPH;
3. two files as TABELS,
4. two files as GRAPHES.

It will then display 35 countries and regions for selection, and will ask the user to choose one from the Data FILE. If he does so, he will see something like Figure 6.8 (this case TABLE for Middle East Region):

| Years | Mid East Oil Used MTonnes | |
|---|---|---|
| 1977 | 78.9 | |
| 1978 | 81.5 | |
| 1979 | 75.4 | |
| 1980 | 82 | |
| 1981 | 89.5 | |
| 1982 | 103 | |
| 1983 | 115 | |
| 1984 | 109 | |
| 1985 | 108 | |
| 1986 | 108 | |
| 1987 | n a | |
| 1988 | n a | |
| Please type: | 1 to graph these items<br>2 to print this table<br>3 to see index&ratio<br>0 to return to the main menu | |

Figure 6.8 Middle East oil used 1977-1988

If, back on the main menu, the user choses *2*, the tables and graph facilities will be displayed very like the last display.

If he choses *3*, then he could create his own data, and the computer will table and graph it if he wishses. For example, the computer will give the last table with just half a column (Years), then it will ask the user to complete the rest.

Three types of Workskeet are included in the BPEF:

- forecasting: one double side page explaining the forecasting with/without model;

. some empty maps: required to answer some questions in the worksheets,

. student Worksheets: these give the student some instructions, then ask questions relating to the screen situation. Here is an example of a Worksheet:

Worksheet 4

World Energy

Requirements: The BP Energy File Disk
Reference Sheet
Pencil and Paper

Instruction: Read the questions below, then study the program index to decide which *file* you will need to look at to answer each one. Make notes of any figures or trends you require because the program does not print results.
Write your answers on a separate piece of paper, illustrating them with any graphs or diagrams you think necessary.

Questions:
1. What is the trend in total energy consumption over the last ten years? Can you think of any reasons to explain this?
2. Is the consumption of any type of energy going against this trend? If so, why do you think it is?
3. Which region has the greatest total energy reserves?
4. If world gas consumption remains the same as last year, how long will the published-proved natural gas reserves last?
5. Calculate which of the major coal producers will use their reserves first, assuming production remains at last year's level.

Because it is menu-drive, the BPEF requires less understanding on part of the user of both databases and the process of database enquiry.

In contrast with QUEST, the BPEF database showed easier but more specific type of generic software. Both databases were established some years ago during the early period of using generic software in teaching. QUEST has a weakness with its relatively difficult commands, while the BPEF is not a typical generic software where the user is free to put his own content.

More recent databases, however give the user freedom to put whatever he wishes. For example, DataEase and Works for Windows both use Windows environment, which has friendly menu-drive, more options and is totally free for the user's data.

# PART B: SPREADSHEET

Spreadsheets have a wide range of uses in the commercial sector. Some spreadsheets are more powerful than a database and often have more statistical options such as calculating, summating and analysing the data. Recently, the commercial market has witnessed a rapid increase in the availability of better and easy spreadsheet packages for Microsoft Windows and Macintosh. For example, *Personal Computer World* (a commercial magazine) devoted almost all the 500 pages of the March 1993 volume to reviewing and advertising spreadsheets. At that time, John Barnes, the Group Editor said: "One spin-off of this increase in the number of Windows products has been the opening up of the spreadsheet market to non-expert users." (PCW, p. 9)

## 6.5 What is a Spreadsheet?:

Originally, a spreadsheet was a large page of paper, divided into two parts: horizontal rows and vertical columns, and used by accountants for calculations. With the arrival of computers, the spreadsheet has became somthing more elegant. Numerical data can be based in the computer's memory and can be processed and modified in various ways. If the data are interrelated, then the relationship issue can be seen immediately on all relevant numbers. The computer can present data results in whatever form the user wants: tables, graphs as well as a number of numerical and alphabetical styles.

A microcomputer spreadsheet is a rectangular format of data set out in rows and columns. In some sheets, columns are labelled using letters of the alphabet and rows are labelled numerically. In the spreadsheet system, an individual entry, or <u>box</u>, can be identified as for instance F5, Z13 etc.

Each spreadsheet box in the grid is known as a <u>cell</u>, and the cells may contain formulae that can define the contents of one cell in terms of the contents of other cells on the spreadsheet. What arises in one cell may be the result of adding together the contents of several other cells. Osborn (1987) identified three purposes for each box:

1. to store and display text, such as an explanatory heading for the contents of a column;
2. to store and display a number, i.e. an item of data;
3. to store a mathematical formula, and display the numerical result of this expression, acting upon data already present in the spreadsheet.

Once in the spreadsheet, data can be subjected to a wide range of arithmetic transformations. These include addition, subtraction, multiplication and division of single boxes, whole columns or rows by constants or by other columns and rows on the spreadsheet. Trigonometrical functions, logarithms, exponential and square roots may also be available. Averages of values in columns or rows can also be taken (Chamberlain & Vincent, 1989).

A spreadsheet is a problem-solving tool allowing the user to represent problems with a 'model' that can be use to explore what happens to some numbers if he changes others on the spreadsheet. It can be an extremely powerful tool that can take the drudgery out of recalculating sets of symbols. It can give the user a completely free focus or the best solution for his problem in a very simple way.

The flexibility of a spreadsheet is invaluable in all kinds of financial planning, but this may be only the most obvious class of applications. When solving a problem with a spreadsheet, one does not think of it linearly; it is not necessary to break the problem down into step-by-step sequences. Instead, the user specifies a series of relationships between columns and rows in any order he pleases. It is also very easy to modify a spreadsheet "program"; and adjust whichever relationship it is desired to alter (Tinker, 1984).

## 6.6 Using Spreadsheets in Teaching:

A spreadsheet can be thought of as a program within a program. Following simple guide-lines, teachers and pupils can draw up their own templates by entering data and formulae into the spreadsheet package. They know exactly what information is available from it and are secure in the knowledge that it is entirely appropriate for their specific requirements in the classroom.

One of the greatest advantages of a spreadsheet is that teachers can generate simple templates without the need for complex formats. When shown clearly how the formulae are structured, pupils find it easy to use them, can readily understand them, and soon learn to generate new ones for themselves. This instant accessibility, even to the youngest secondary pupils, is perhaps the spreadsheet template's greatest appeal as a teaching aid (Black, 1987).

Another advantage of spreadsheets, as compared with CAL packages, is that large amounts of numerical data are accessible on the screen in the spreadsheet window at the same time as the graphical displays. This not only makes it easier to access any required data by simply 'scrolling' the relevant window, but also helps the student by giving an overview of the data available, its associations, and links to the charts which are also displayed. New values for quantities entered in the spreadsheet are immediately reflected in changes to calculated quantities and to graphical displays. This contrasts with CAL simulation where new values of variables for the pre-stored model have to be entered via a set sequence of commands. The benefit is that students feel much more directly in control of the data than when it is built into a sequential or semi-sequential type of program (Beare, 1992).

Black (1987) suggested three methods for using spreadsheet in teaching.

1. Co-operative method: This method usually involves the teachers setting up a template spreadsheet. Pupils collect data for the spreadsheet, then type the results into the appropriate place.

The co-operative method of using the computer is suitable for use in the science laboratory when only one computer is available.

2. Sewing machine and tool box method: In contrast to the previous method, when using this method, the computer should be readily available for use by the pupils, with a variety of software available.

The advantage of using this method is that pupils have an extra tool for learning and reinforcement of ideas, as it gives more time for discussion and hypothesis formation.

3. Battery method: This method requires at least one computer used by two pupils, so each pupil gets the required amount of skill-learning time. The teacher sets his pupils tasks, gradually building up their computer skills. He carefully selects the tasks to simulate life situations. The pupils should have a spreadsheet guide to help them, and the teacher assists and advises them as necessary.

The advantages of using the battery method are: all pupils get equal time and opportunity to use the computer and spreadsheets; the pupils are put into real life situations with some of the latest technology; and the activities can be structured to provide a suitable learning tool.

## 6.7 Examples of Spreadsheet use for Science:

In the last few years, several studies and articles have appeared which illustrate the use of spreadsheets for various purposes in science education, for example, Ogborn, 1987; Osborn, 1987; Elliott, 1988 and 1992; Chamberlain & Vincent, 1989; Brosnan, 1989 and 1990; Finnemore, 1990; Stephens, 1991, and Beare, 1992.

The following section presents two types of spreadsheet and examples of their use in science teaching. In contrast with the previous database examples, the spreadsheet examples have used more modern generic software packages. The following two examples are totally free-content.

### 6.7.1 MULTIPLAN (MPLAN):

MULTIPLAN is a spreadsheet package available on a wide range of business microcomputers. It allows the pupil to manipulate data quickly and accurately. The pupils can examine a larger number of data sets than with traditional methods. MPLAN allows hypothetical deductive thinking, which in turn promotes a problem-solving approach to teaching. Pupils can develop their own spreadsheets as tools for solving their own problems. The worksheets included with the school package deliberately represent a range of different styles so that the teachers can consider what suits the individual needs of their pupils.

The MPLAN spreadsheet can be used by middle and secondary school pupils. An example of the use of MPLAN in science is: a group of pupils, collect details on the properties of different materials with the intention of establishing which ones are metals. The pupils list these properties: names, colour and shape, whether or not the various materials were good conductors and whether they changed shape with hammering. They take it in turns to enter their results on to the spreadsheet. The conducting qualities and the change of shape indicates whether or not the materials are metals. The spreadsheet is able to sort columns to give pupils the information they require. Once all the results of the investigation have been recorded, they are printed in table form similar in function to the database, but with easier entry and more compact presentation (see Figure 6.9 below).

| NAME | COLOUR | SHINY/ DULL | FORM | HAMMER. | CONDUCT | MTL/NMT |
|---|---|---|---|---|---|---|
| CHARCOAL | black | dull | lump | no | no | NMETAL |
| CALCIUM | grey | dull | lump | no | no | METAL |
| LEAD | black | dull | lump | yes | yes | METAL |
| IRON | silver | shiny | lump | yes | yes | METAL |
| IODINE | grey | shiny | powder | no | no | NMETAL |
| SULPHUR | yellow | dull | powder | no | no | NMETAL |
| ALUMIN. | silver | shiny | lump | yes | yes | METAL |
| GRAPH. | black | dull | lump | no | yes | NMETAL |
| COPPER | bronze | shiny | lump | yes | yes | METAL |
| TIN | silver | shiny | lump | yes | yes | METAL |
| MAGNES. | silver | shiny | lump | yes | yes | METAL |

Figure 6.9 Example of MPLAN table

The following example uses the sewing machine and tool box method with MPLAN. It shows use of the instant calculation facility. The teacher sets the class tasks: prepare, cook and serve a mid-day meal for 2 students who require an adequate supply of protein, but only have **1.50** to spend.

Pupils can choose the best information to help them from the menu of resources. This could include food tables, recipe books, price lists, literature on meal planning, and the computer. If the pupils choose the computer to help them, they could again select from the menu of software available. In this case the teacher has prepared a spreadsheet with the current prices of foods containing protein, and their actual protein content

(Figure 6.10).

| PROTEIN | | | | | | |
|---|---|---|---|---|---|---|
| FOOD:COOK | ORIGINAL UNIT | ORIGIN COST | COST/ 100G | PROT/ 100G | COST 1G PROT | VAL.FOR MONY |
| MINCED BF | 500.00 | 1.15 | 0.23 | 18.80 | 0.01 | excell. |
| ROAST CHIC | 500.00 | 1.20 | 0.24 | 24.80 | 0.01 | excell. |
| MILK | 566.00 | 0.24 | 0.04 | 3.30 | 0.01 | excell. |
| YOGHOURT | 150.00 | 0.18 | 0.12 | 5.00 | 0.02 | poor |
| FISH | 500.00 | 1.20 | 0.24 | 13.50 | 0.02 | excell. |
| . | . | . | . | . | . | . |
| . | . | . | . | . | . | . |
| . | . | . | . | . | . | . |

Figure 6.10 Example of MPLAN using calculation facility

It is possible to use the battery method. For example. The pupils have the following data:

| Address | Name | status | initials | het.now | last |
|---|---|---|---|---|---|
| 1Hull St. | A | Mr | D | 34315 | 34809 |
| 2Hull St. | B | Mr | Z | 07435 | 06732 |
| 3Hull St. | C | Miss | J | 14762 | 12391 |
| 4Hull St. | D | Miss | P | 64809 | 64580 |

Figure 6.11 Meter readings on the 1st August 1992

standing charge 6.37p
charge per unit 5.42p

The pupils are then asked to use the spreadsheet to calculate the therms used, and their total cost, including the standing charge. The pupils could also use the spreadsheet to help them forecast future costs and developments.

A MPLAN package for schools includes some worksheets to help pupils use the spreadsheet. One worksheet example is as follows:

Worksheet for elements.SCC

Use the TO START guide to help you load ELEMENTS.SCC.

On the screen you will see:
Column 1 several elements listed in alphabetical order.
Column 2 their atomic number.
Column 3 the number of electrons in the outer shell.
Column 4 metal or non-metal classification.
Column 5 the melting point, in degrees C.
Column 6 the boiling point, in degrees C.
Column 7 the state, solid(s), liquid (1), gas(g) at room temperature.
USE THE SORT COMMAND TO ANSWER THE QUESTIONS
TO SORT
Select the SORT command TYPE S
You will see the sub command at the bottom of the screen.
SORT by column :1 between rows:1 and:255 Order:(-)3/4
When you have decided which column and rows you want to sort, TYPE these numbers in the appropriate space. To move from one command to another use the TAB key.
Note:
- this means in ascending order.
3/4 this means in descending order.
QUESTIONS
1 Which element on the spreadsheet has the lowest atomic number?
..................................................
2 Which element on the spreadsheet has the highest atomic number?
..................................................
3 Which elements have 4 outer shell electrons?
..................................................
4 Do these outer shell electron numbers relate to any other section of the Periodic Table?
5 Explain your answer to question 4 by giving a further example from the information on the spreadsheet
..................................................

## 6.7.2 EXCEL:

Excel is a spreadsheet widely used in the commercial sector as well as in education. The suitability of this spreadsheet for subject teaching led the majority of UK secondary schools to buy it in its early version, that of 1990. In 1992, Microsoft produced a new Windows versions (4.0) of Excel for both IBM compatibles and the Macintosh family. The new versions provide further powerful facilities for both business and educational sectors (Figure, 6.12).

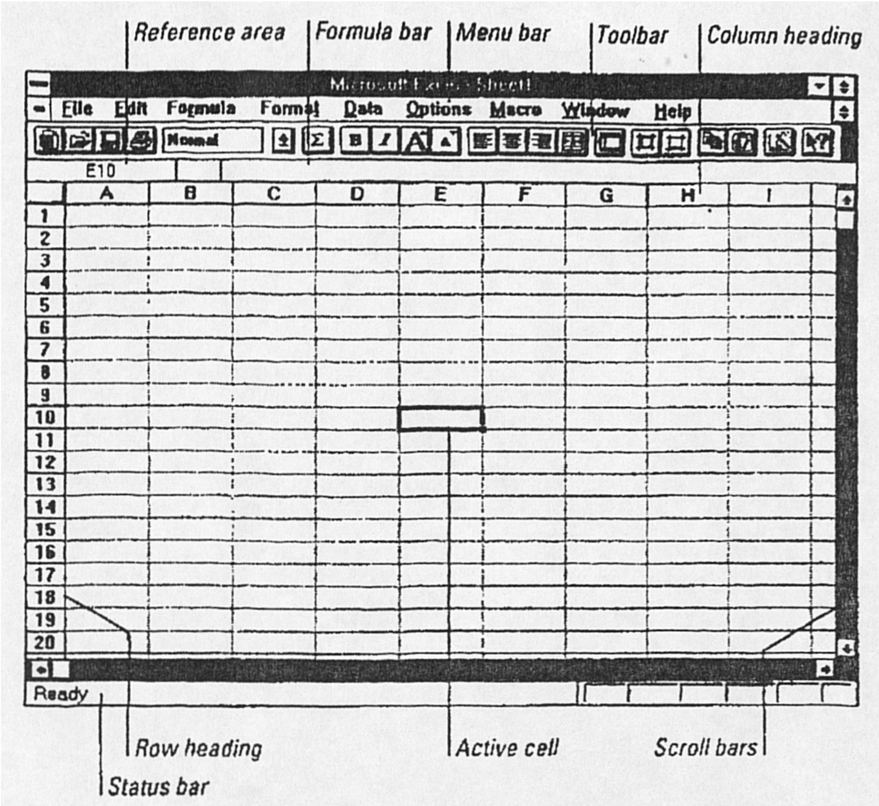


Figure 6.12 Excel main menu.

Figure 6.13 shows that there are nine "tools" in the tool-bar line of the display as a default: Standard, Formatting, Utility, Chart, Drawing and Excel 3.0, and three for macros. The most useful button on the standard toolbar is the one that automatically determines which columns of figures you wish to add up and sums them. The formatting toolbar offers control over the font, font size, emphasis and styling of numbers. One of the great features of Excel is its Utilities toolbar, which has the ability to define outlines. Treating lines of numbers like lines of text in a spreadsheet outliner allows the user to condense the area of expenditure into a few lines to give an overview, or expand them to show detail. The spreadsheet is also provided with a spelling-check, as well as various figure options, including chart and drawing tools. Excel has special interactive help in the form of the Chart Wizard which asks the user about the type of chart he wants to create, before creating it. A user can choose between charts which look good but are hard to read, such as stack and 3D bar graphs, and those which look plain but are easily interpreted, such as line graphs and pie charts.

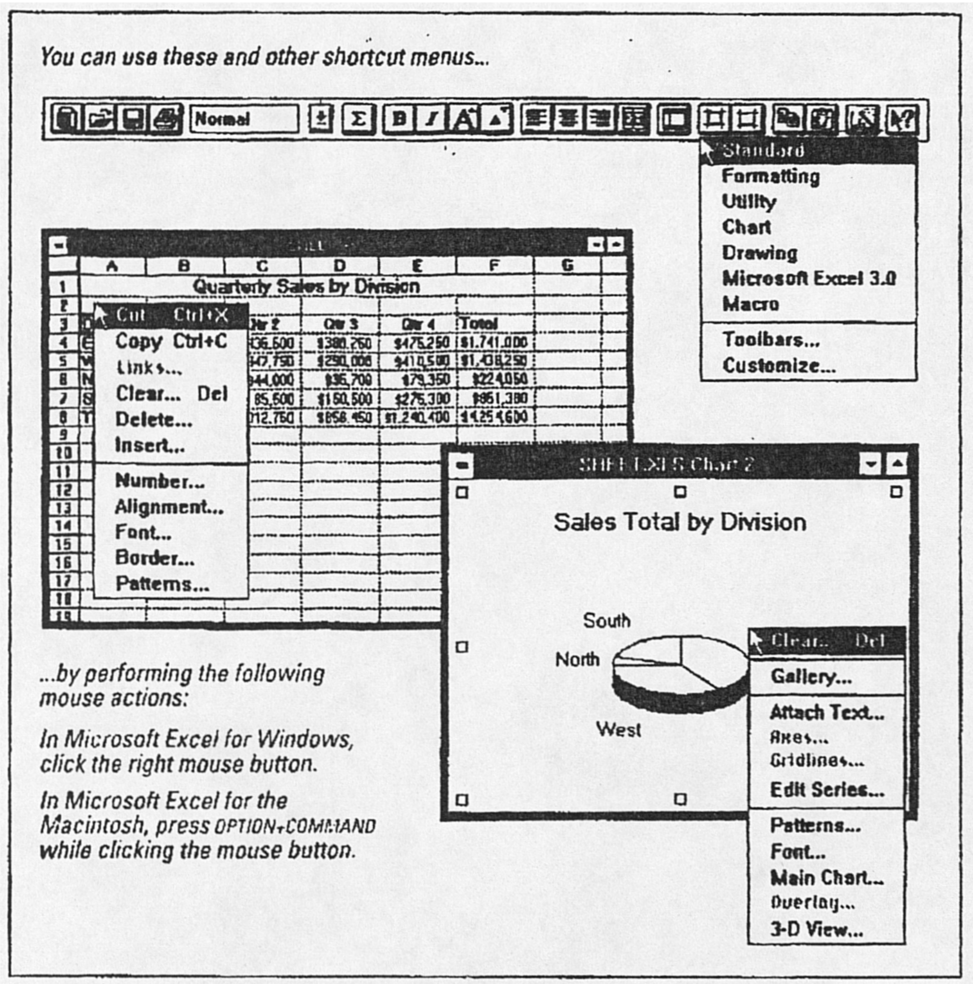


Figure 6.13 Different options of Excel.

Excel also provides advanced analysis functions, including finding values through interaction. The function can either cycle a number of times or until the value found stops changing within a certain tolerance. It has many statistical analyses for many types of data. It also provides an area of the screen into which the user can put his data and the results are presented in another range of cells.

The spreadsheet allows the user to store, manipulate, calculate, and analyse data such as numbers, text, and formulas. It is possible to add a chart directly to the worksheet and add graphics elements such as lines, text boxes, and buttons on the worksheet. Cell styles, drawing tools, charts gallery and tables can be used to produce high quality presentations. These can be displayed directly on the screen or printed. Additional to its chart options, it is very easy to operate, via pull-down menus, windows and a muse.

Today, Excel spreadsheet is perhaps the best known spreadsheet among science teachers in the developed countries. Almost every UK secondary school has a copy and it is used mostly for science teaching.

In additions to its IBM and MAC versions, Excel has recently launched new versions in international languages including Arabic, and is available now in the Saudi Arabian market.

Excel spreadsheet is a powerful tool for science teaching. An example of a science topic which could be taught by Excel is "Density"[1]. The science teacher could give his students regular blocks of say 10 materials. The teacher enters the substance names in the first column in the

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[1] Density occupies two lessons in the Saudi Arabian Physics curriculum in the second year of secondary level (Ministry of Education, Physics curriculum, 1993).

spreadsheet, lets his students weigh each substance and enter mass values in the second column. The students also measure each substance length, width and height, and entering them in the next three columns. By using the spreadsheet calculator facility, the students then calculate volume for each substance and then the density for each material (Figure 6.14). The students devise a formula for the sixth column (volume), as: Volume= Length x Width x Height, and the seventh column (density) as: Density= Mass/Volume, Excel can automatically then calculate the volume for each substance and the density for each material, after they have entered the valuses of each substance.

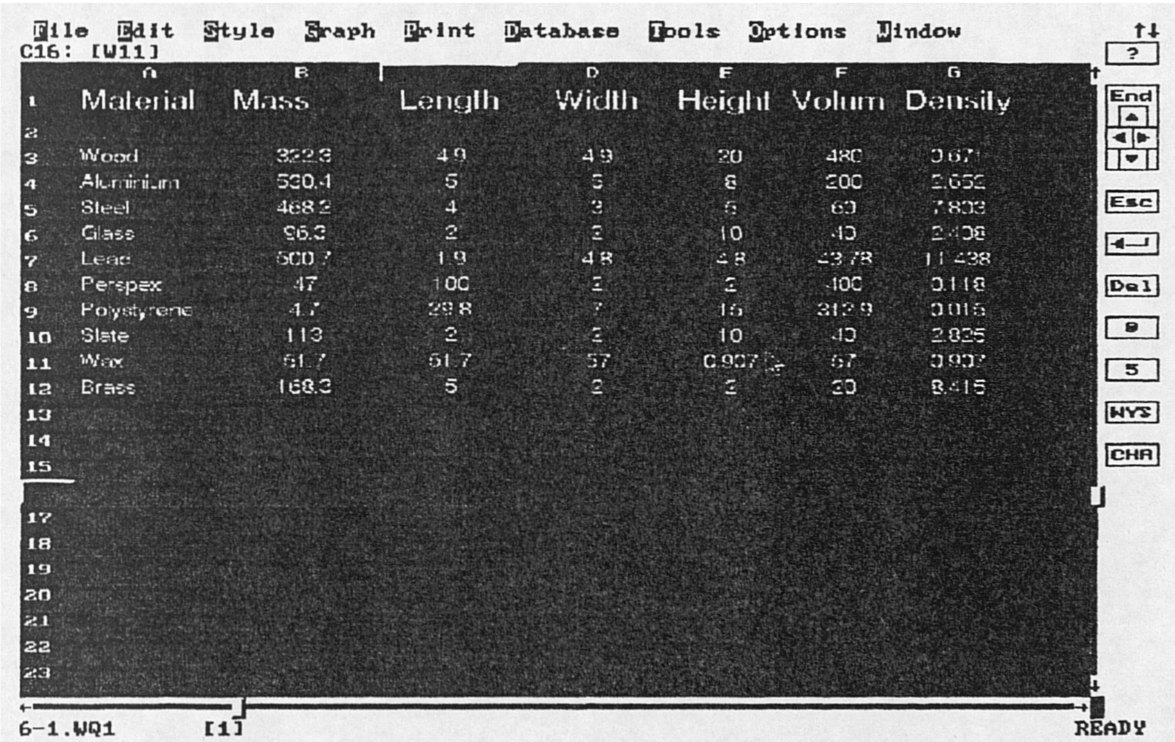


Figure 6.14 Spreadsheet display: Name, Mass, Length, Width, Height and output: Volume and Density of 10 material blocks.

Pupils could display the material names and densities on bar or pie charts as they wish. From charts such as Figure 6.15, pupils could build up their understanding of low/high density for different materials, easily comparing them. The spreadsheet can order the materials according to their density from the highest to the lowest or vice versa. The pupils could also translate the relationship between mass and volume in "line" or "XY" charts.

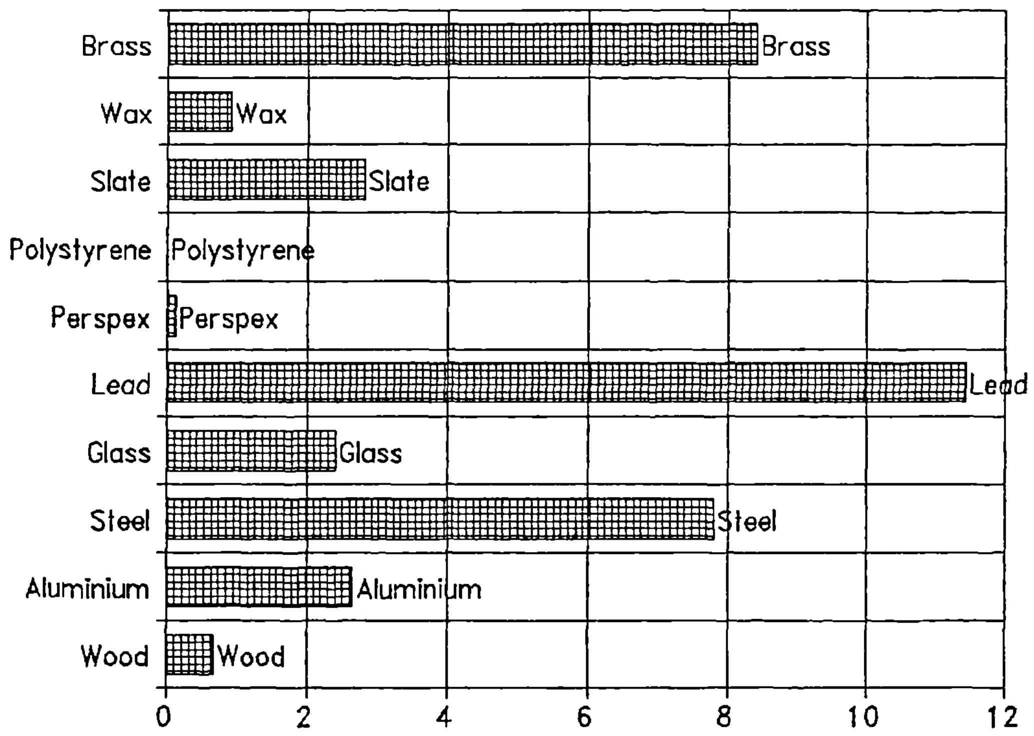


Figure 6.15 Excel chart shows Density by material

Worksheets for Density:

* If you have 1g of water in a cube of 1 cm length, 1 cm width and 1 cm high, and therefore 1 $cm^3$ density. Enter these values within the last example, and from a chart try to find out which one of the 10 substances (materials) will sink in the water or float on the water. Could you tell why?

* You have three pieces of wood; a valuable piece of gold has been hidden in one of them. Use Excel to find out which one is valuable.

# PART C: OTHER APPLICATIONS

## 6.8 Wordprocessor:

A wordprocessor is a program that allows the user to use the computer to write, edit, and print documents quickly, easily, and professionally. He can compose short documents like lists, memos and letters, or he can generate longer articles and reports. He also can save his documents, as long as he wishes, and print them at any time.

In a wordprocessor, the screen is often divided into three sections. The first is an area where the text being worked on is displayed. New text is added to this area and this 'window' can be moved to display other sections of the file being used. The second is a smaller area which gives information to the user, such as the name of the current file, the position within that file, the position of the cursor on the screen and other relevant information such as the date and time and any information about the state of the host system. Finally there is a menu area where the user is shown or can enter commands such as edit, save, move and print (Williams & Maclean, no date).

Wordprocessing is generally a student's first opportunity to experience the value of a computer as a personal tool. Early wordprocessing software was designed for adult users, but in the last few years, a number of user-friendly, menu-driven packages designed specifically for younger users have appeared on the market. As a result, an increasing number of elementary school children and their teachers are realizing the advantages of using a computer to aid the writing process (Langhorne, et al. 1989).

Secondary school students should have available to some of the software designed to facilitate effective revision skills through text analysis. Spelling and grammar checking programs can be used with some wordprocessing programs to highlight problem points in the text for the student to consider and correct. They can assist self-editing of surface writing problems, allowing the student to correct some errors before submitting the document to the teacher (Langhorne, et al. 1989).

Although the purpose of introducing WP to the classroom was to improve the teaching of language, including writing and reading skills, it is also possible to get some benefits for other subjects. However, WP is not specific to science, but equally appropriate to social science studies, languages, etc.. For this reason, no further explanation is included.

### 6.9 Electronic Mail:

An Email service allows users to exchange messages with other users through computer networks that include JANET, ARPANET, and CSENT, etc. It is a modern method of communication which has grown rapidly in the last few years. The advantage of using Email is that it is cheap, convenient and very quick, especially for those who spend most of their time using computers.

A student using Email needs to type in message-file by using wordprocessor facilities. He also needs to know the receiver's school-address (locally or abroad), then he can send a message or reply to his friend or colleague.

Email could allow pupils in different schools, LEAs or even different countries to exchange information, for instance, about their local weather. Take this imaginary message between two science pupils, one living in Hull, another living in St Andrews (Scotland):

*To:* X@uk.ac.st-andrews
***Subject:*** Hull weather
***Text:***
:Dear Y,
:Our weather this afternoon is a few bright intervals, but a good deal of
:cloud and a strong and gusty wind, the temperature is 14c. But I expect
:it to remain cloudy with wind and rain during the night.
:Bye, X.
:.

The St Andrews pupil then will receive:

***Subject:*** Hull weather
***From:*** X@uk.ac.hull
***Date:*** Thur, 7 Nov 92 01:24:17
***To:*** Y@uk.ac.st-andrews

Dear Y,
Our weather this afternoon is a few bright intervals, but a good deal of cloud and a strong and gusty wind, the temperature is 14c. But I expect it remain cloudy with wind and rain during the night.
Bye, X.

For such a message, pupils can still prepare their data for some experiments or tasks, and then copy and exchange them with their colleagues in other school(s) using a wordprocessor for typing the message and database for exchanging information. This would give them Email, WP and DB awarenesses (part of computer awareness) as well as confirming their science concepts.

Email is not just another interesting computer development of which pupils need to be aware. There could be applications within the curriculum in different subjects. It is best utilised in the classroom where pupils exchange data or information; that is, when used as an integral part of a lesson (Northwood, 1991).

Although ideas about the use of Email in science teaching are fresh and it is still not in widespread use, they could soon be practised in schools. It is likely to be a rapidly-growing field.

### 6.10 Data Logging:

"Having a computer in every laboratory should be every science department's first computer-related priority." (Kahn, 1985, p 50)

The idea behind datalogging is that by using a computer to streamline the mundane, tedious tasks of data collection, the students are encouraged to concentrate on designing the experiment, predicting, and analysing the results. The computer becomes a piece of laboratory equipment (Langhorn, et al. 1989).

Datalogging gives the pupils the opportunity to work in small groups to collect, investigate, analyse and also graph the data relating to, for example their own heart rate in a short time, and perhaps with equal or even greater success than the traditional science laboratory in terms of the pupils' attitudes and achievement. In this case, the pupils do not need to spend a long time doing tables, calculating, and attempting to produce complicated or even impossible graphs, because the computer can do all of these in a very short time.

Datalogging is a powerful tool in the hands of the science teacher, to save his and his pupils' time. Today, many experiments can be done in one class, with just two or three machines, because pupils could be divided into groups, variously investigating, collecting data or introducing them into the computer. In this respect, conventional experiments would be extended rather than replaced and the pupils would carry out practical experiments as well as gaining experience in computer-datalogging.

Because the main uses of datalogging are in the science laboratory, rather than the actual science classroom, no examples are presented here. However, they can be found in a practical datalogging project which was based at Leicester University School of Education and summarized by Barton (1991). The summary shows pupils' involvement using datalogging in some physics experiments such as temperature measurement, motion and electrical measurements. Another project was described by Chamberlain and Vincent (1989).

## 6.11 Conclusion:

This chapter has described five types of generic software applications. Databases and spreadsheets were presented in depth because they have a very wide range of potential use in science classrooms. Examples of the use of these two types in the science classroom were also presented.

The chapter has shown the flexibility and applicability of generic (tool-kit) computer software in subject teaching generally and science particularly. These approaches can be successful for developing students' skills, such as problem-solving, thinking skills, etc., as well as their awareness of computer applications widely used in commercial and daily life.

The ease of use for both teachers and students may be the main reason behind the widespread introduction of the generic applications into industrial countries' schools. The need for simple and cheap software, however, is particularly urgent in the developing countries, where lack of computer awareness and shortages of teacher training are common. The introduction of generic applications into science teaching in Saudi Arabia as a developing country needs careful investigation of teachers' attitudes, views and ideas toward training and use of these applications in the science classroom. These issues are the main reason for carrying out the main field study explained fully in the following four chapters.

# CHAPTER 7 : :
# CONSTRUCTION OF INSTRUMENTS FOR SAUDI ARABIAN STUDY

## 7.1 Introduction:

The main aim for the main field study in Saudi Arabia was to investigate science teachers', advisors', trainers' and computer studies teachers' views and attitudes toward the introduction and use of computers for science teaching. It also examined official views toward facilitating the introduction and use of computers into science classrooms.

The study was intended to make an assessment of the attitudes of science teachers and educators. To generalize this assessment for SA as a whole, required a large sample of both science teachers and computer studies teachers and as many science trainers and advisors as conveniently possible. It was decided therefore to measure these samples' attitudes by using a questionnaire survey.

The most popular form of attitude measurement is by means of a questionnaire consisting of attitude items, each item belonging to one scale which providing a means of quantifying respondents' views. The items often contain a choice from a range of numerical values for each statement (item) about which people express their agreement, or dis-agreement, along a continuum (Thomas, 1978).

Suitable instruments were sought because the preliminary field study (Chapter 5) indicated lack of computer experience and background among SA science teachers and educators. For example the study findings indicated that some technical questions should be ignored and others expanded or replaced according to the responses and suggestions of the interviewees. Questions like "Could you tell me what is a hard disk and what is a floppy disk? " and "Do you know what is BASIC language?"[1] were found difficult for the teachers to understand, as a result, only a few teachers responded to such questions.

Unfortunately, no instrument suitable for the SA samples was found. Previous studies of attitude toward computers had been directed to students, teachers, computer professionals and\or those <u>with computer knowledge</u>. For instance, Mathews and Wolf (1979), Minnesota Educational Computing Consortium (MECC) (1979), Wilson and Ternary (1981), Reece and Gable (1982), Moore (1984), Banks and Havice (1989), Ransley (1991) who developed or used instruments for measuring one or more aspect of students' attitudes towards computers.

In contrast to the widespread attention to <u>students</u>' attitudes, the studies which concerned subject <u>teachers</u>' attitudes were mostly directed to teachers who had some knowledge or/and experience of computers.

Studies of Lichtman (1979), Clement (1981), Miller (1981), Jay (1981), Bitter and Davis (1985), Lawton and Gerschner (1982), Smith (1984) were

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1. Items 2 and 3 in knowledge part of science teachers interview schedule Appendix C.

all designed to be used with teachers who already had computer experience as Moore (1984) confirmed in his review of previous studies of attitudes. Early studies reviewed by Moore used the Ahl[1] questionnaire which was designed originally for adults, who used or had experience with computers. Later studies including those of Beare, et al. (1987), Moore (1989) and Boyes and Thyagarajan (1992), have all been concerned with students' attitudes, whilst, Abdel-Gaid, et al. (1986) and Marion (1988) compared preservice and inservice teachers' attitudes; both of their questionnaires require respondents to have some computer knowledge and awareness. However some studies examined teachers' attitudes after they had attended a computer course. For example, Bitter's study was a survey of 300 teachers who had participated in a computer literacy program. Underwood and Underwood (1989) used 313 teachers and trainees who were to start a compulsory computer literacy course.

The absence of studies related to teachers with little experience of computers can be attributed to the fact that these surveys were conducted in developed countries such as USA, UK, Germany, etc., where attention has been paid to computer literacy in the whole of the society. However, less attention has been paid in the developing countries, where the current study is located. The study sought instruments that could be answered by respondents with little computer knowledge and experience.

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1. Ahl, D. (1976). **Survey of public attitudes towards computers in society.** In (Moore, 1984).

Further, this study investigates science teachers' and science educators' attitudes toward the introducing and use of computers for science teaching, while almost all studies mentioned previously mainly measured teachers' attitudes to computers generally. They were not directed to science teachers only but to all subject teachers.

In addition, some studies of teachers' attitudes such as Moore (1987) were concerned with computer studies teachers' attitudes, those who are specialists in computers. The instruments of these studies were not suitable for SA computer studies teachers because an instrument was needed there to measure the SA computer studies teachers' attitudes to using computers to help in science teachers' training and not to measure their attitude toward computers.

Moreover, it was thought that in a society like Saudi Arabia, teachers and educator need an instrument appropriate to their culture, educational system and facilities available in the SA schools. For these three reasons (difference of sample, difference of focus and difference of culture), it was necessary to construct new instruments (questionnaires) suitable for use with SA science teachers, advisors, trainers and computer studies teachers.

## 7.2 Source of the Items:

The preliminary field work (chapter 5) carried out interviews with samples of science teachers, computer studies teachers and science trainers.

The findings of the study were used to develop three types of questionnaires for the main field work: science teachers questionnaire (STQ), science teacher trainers questionnaire (STTQ) and computer studies teachers questionnaire (CSTQ).

Items were drawn up from the findings of each type of interview. Some interview questions that had contributed interesting responses were expanded into two or more items. Other items came from statements by respondents.

Only questions eliciting responses from a majority of interviewees were translated into questionnaire items. Care was taken to avoid the use of technical items or words unlikely to be understood by Saudi Arabian subjects. Items were designed to be clear and unambiguous to teachers and others who had limited knowledge of computer education.

## 7.3 Setting up the Questionnaires:

For setting up questionnaires with opinion or attitude items, it is worthwhile to generate scales comprised of groups of related items. Youngman (1979) claimed "A person's responses to the items can then be combined to produce a score on that subscale, and similarly for the remaining scales. The analysis of subscales scores then becomes no different from that of any other continuous score." (p. 159) The use of scales (groups of items) is found to be more reliable than the use of each item individually.

The first draft of the science teachers' questionnaire (STQ) included four attitude scales of Attitude toward: value of computers for science teaching (VALUE); benefits and problems which they might see in use of computers in their classrooms (BENEFIT); training to use computers in their teaching (TRAINING); the effectiveness or otherwise of pupils' use of computers (EFFECTIVENESS). It also included three sections of personal information: science teachers' computer knowledge (KNOWLEDGE); science teachers' classroom activities (ACTIVITIES); and personal characteristics (CHARACTER).

The aims of including the KNOWLEDGE section were to measure the science teachers' computer knowledge and to obtain data that would make it possible to explore the relation between respondents' knowledge and their attitudes. The aims of including the ACTIVITIES section was to allow a test of whether there is a relation between a science teacher's activity and his attitudes to the introduction and use of computers. Table 7.1a shows the scales and number of items in each scale, whilst Table 7.1b shows the personal information sections and number of items in each section. A typical item is presented for each scale and section as representative of the whole scale or section.

| Attitude scale Name | Scale description | No of items | Typical item |
|---|---|---|---|
| VALUE | Value of computers for science teaching | 15 | Computers bring more disadvantages than advantages to science teaching (-)* |
| BENEFIT | Benefits and problems in use of computers in science classrooms | 10 | Teaching science with the aid of computers would make teaching easier (+) |
| TRAINING | Training to use computers in science teaching | 21 | A computer training programme should be compulsory for every science teacher (+) |
| EFFECTIVE | The effectiveness or otherwise of pupils' use of computers | 20 | Computers are as important to students as text books in the classroom (+) |

* + Positive item, - Negative item

Table 7.1a Attitude scale name, description, number of items and typical item for each scale in the first item-pool used in science teachers' questionnaire

| Section Name | Section description | No. of items | Typical item |
|---|---|---|---|
| KNOWLEDGE | Computer knowledge | 13 | To use a computer successfully, one needs to learn how to program (F)* |
| ACTIVITIES | Classroom activities | 11 | I make personal visits to computer centres |
| CHARACTER | Personal characteristics | 8 | Have you got a personal computer? If yes, for what do you use it? |

* F= False item

Table 7.1b Personal section name, number of items and typical item for each section in the first item-pool used in science teachers' questionnaire

Similar to the STQ, the first draft of the science teacher trainers' questionnaire (STTQ) included four attitude scales of Attitudes toward: value of computers for science teaching (VALUE); the training of science teachers to use computers in their teaching (S.TRAINING); training to use computers in their teaching (TRAINING); the effectiveness or otherwise of pupils' use of computers (EFFECTIVE). In addition, it included two more sections for computer knowledge (KNOWLEDGE) and personal characteristics (CHARACTER).

The scales VALUE, and EFFECTIVE were both similar in both STQ and STTQ because these scales are related to both science teachers and trainers at the same level of importance. In other words it is as important to measure science teachers' attitudes to the VALUE of computers and to EFFECTIVE use of computers by pupils as its for science trainers. The scale TRAINING had almost similar items, but items were changed to reflect occupation, i.e science teachers and science teacher trainers as shown in Table 7.2a.

| **Attitude scale Name** | **Scale description** | **No. of items** | **Typical item** |
|---|---|---|---|
| VALUE | Value of computers for science teaching | 15 | Computers bring more disadvantages than advantages to science teaching (-)* |
| S.TRAINING | Science teacher's training | 11 | Science teachers should have INSET in the use of computers in their teaching (+) |
| TRAINING | Computer training | 17 | A computer training programme should be compulsory for every science teacher trainer (+) |
| EFFECTIVE | Effectiveness or otherwise of pupils' use of computers | 17 | Computers are as important to students as text books in the classroom (+) |

* + Positive item, - Negative item

Table 7.2a Attitude scale name, number of items and typical item for each scale in the first item-pool used in science teacher trainers' questionnaire

| **Section name** | **Section description** | **No. of items** | **Typical item** |
|---|---|---|---|
| KNOWLEDGE | Computer knowledge | 13 | To use a computer successfully, one needs to learn how to program (F)* |
| CHARACTER | Personal characteristics | 10 | Have you written any article or conducted research about computers? If yes, was it theoretical or practical? |

* F= False item

Table 7.2b Personal section name, number of items and typical item for each section in the first item-pool used in science teacher trainers' questionnaire

Table 7.2b shows the two personal information sections used in the first draft of STTQ. The knowledge section was similar to that in STQ, while two more questions related to previous involvement in computer research were added to the STTQ.

Because computer studies teachers have no involvement in science teaching, tha CSTQ scales and sections were different from those in the STQ and STTQ. The scale, "Relationship with Science Teachers" was expanded in the CSTQ and renamed as "Attitudes toward training science teachers to use computers in their teaching" because the preliminary findings suggested an important role for computer studies teachers in science teachers' training. Tables 7.3a shows the CSTQ attitude scales of Attitudes toward: value of computers for science teaching (VALUE); training science teachers to use computers in their teaching (ST.TRAINING); training in teaching methods (TRAINING); and personal information. One typical representative item is shown for each scale and section.

| Attitude scale Name | Scale description | No. of items | Typical item |
|---|---|---|---|
| VALUE | Value of computers for science teaching | 16 | I think it is enough for pupils to study computer studies courses (-) |
| ST.TRAINING | Training of science teachers | 27 | I would be willing to train my science colleague to use a computer in his teaching (+) |
| TRAINING | Training in teaching methods | 11 | A computer studies teacher does not need to be trained in teaching if he has enough knowledge of his subject (-) |

Table 7.3a Attitude scale name, description, number of items, and typical item for each scale in the first item-pool used in Computer studies teachers' questionnaire

Although the VALUE scale measured one aspect in all of the three questionnaires, special items were required for CS teachers only. For example, item 13 was "*The increased use of computers in schools subjects will cause less favourable student attitudes toward computers*". ST.TRAINING was also different in both STTQ and CSTQ because STTQ is mainly concerned pre-service training, whereas CSTQ concerned INSET. Moreover, CSTs CHARACTERs questions were designed to measure CSTs previous technical training and experience, see example Table 7.3b.

| Section Name | Section description | No. of items | Typical item |
|---|---|---|---|
| CHARACTER | Personal characteristics | 10 | Have you been trained in using computer networks? |

Table 7.3b Personal section name, number of items and typical item in the first item-pool used in computer studies teachers' questionnaire

It was decided to remove the section asking for "Actual Information" from the CSTQ because the preliminary study gave enough background information about computer provision in the secondary schools.

## 7.4 Validity of the Questionnaires:

To confirm the relevance of the items to their scales and sections, copies of the STQ were distributed to a trainer at an English University, six science teachers at three English secondary schools and five students undertaking a one year post graduate course in education (PGCE) in secondary science teaching 1991\1992 at an English University. The CSTQ was also distributed to a trainer at English University, three IT teachers at the same three schools and five PGCE students undertaking computer studies in 1991\1992. At the same time, copies of the trainers' questionnaire were distributed to four science trainers at an English University.

All respondents received a copy of the questionnaire with a letter indicating the nature and purpose of the study and questionnaire and stressing that they are <u>not</u> asked to respond to the items ( whether they agree or disagree), but to respond to whether the items <u>belong</u> to their scales or not.

To obtain their views about the strength of the relationship between each item and its scale or section, the respondents were asked to tick one of four boxes: NR (not relevant), MR (minimally relevant), FR (fairly relevant) or VR (very relevant). They were also invited to make any suggestions about the items, scales (appropriateness of items) and questions. They were also asked to indicate a more suitable scale for any items which they thought did not belong to their current scale.

All questionnaires were collected personally. Almost all of the respondents were interviewed after they completed the questionnaire and invited to give their opinion about the questionnaire.

The responses were coded as NR=1, MR=2, FR=3 and VR=4. The data were analysed by using the MEAN. All items below the mean (2.5) were removed, or replaced if some respondents suggested that, whilst all items above the mean were retained.

Table 7.4 shows that only 9 items from 75 items in the STQ were removed, and even less than this number in the cases of STTQ and CSTQ, they were just 4 or 5 items in these two questionnaires. That means that the respondents agreed that 88% of STQ items belonged to their scales, 94.5% of STTQ items belonged to their scales and 91% of CSTQ items belonged to their scales.

| Ques. name | No. of items removed | No of items replaced | No of retained items |
|---|---|---|---|
| STQ | 9 | 5 | 66 |
| STTQ | 4 | 6 | 69 |
| CSTQ | 5 | 3 | 52 |

Table 7.4 Number of items removed and number of items replaced in each type of questionnaire

The replaced items were switched to a more appropriate scale or section within the questionnaire according to the suggestions made by the respondents in the questionnaires or in the interviews.

At this stage the treatment of the English of the questionnaires was finished.

## 7.5 Translating the Questionnaires into Arabic:

In order to apply the questionnaires in Saudi Arabia, they were translated into the SA mother language, Arabic. The translation was designed to retain the items' English meaning and to be as simple as possible for general understanding.

To ensure that all items retained their English meaning, English and Arabic copies of each questionnaire were shown to a science teacher at an English school, whose mother language is Arabic. He suggested slight changes. For example, he suggested more explanation of the word "spreadsheet" in the computer studies teachers questionnaire, because spreadsheet is not a common noun in the Arab computer sector, but Lotus 1,2,3 are surely familiar. So it was decided to explain the spreadsheets items by the example of Lotus 1,2,3. He also recommended renaming the science trainer, "science supervisor", because this is the name normally used in the Arab academic sector. His comments and suggestions were implemented before further testing of the questionnaires.

## 7.6 Timing the Items:

"One effective way of detecting potentially difficult questions is to pilot them by administering the questionnaire personally, timing each response. Any questions which take substantially longer to answer than others quite likely are too complicated. They should be reworded, or broken down into separate parts." (Youngman, 1982, p. 12)

To make sure that all items were easily understandable by native Arabic speakers, each questionnaire was distributed to postgraduate Arab students at an English University. Copies of both STQ and STTQ were distributed to three students undertaking PhD studies in science education, whilst copies of CSTQ were distributed to three students undertaking PhD studies in computer science or engineering. The time taken to answer each item was recorded in each case. From these records the mean time for each item was calculated and analysed. Any item which took more then 15 seconds was treated as a difficult item and reworded in a simpler way.

## 7.7 Piloting the Questionnaires:

Before carrying out the main study and distributing the questionnaires to the samples, it was important to make sure that the instruments were suitable for use with this particular sample. The aim of piloting the questionnaire was to explore any possible problems within the questionnaire and solve them. Youngman (1982) claimed that "Piloting is an integral part of any research and a questionnaire survey is no exception. Indeed the strong dependence upon the instrument rather than the researcher makes pilot assessment even more necessary. They need to evaluate the instruction, the questions and response system." (p. 26)

The pilot study concerned questionnaires rather than sample, so it normally involved a small sample of the main study (Youngman, 1982). It was required to choose a small representative number of the main sample with if possible 100% responses in a short time. Selective samples were therefore chosen as convenient and according to their willingness to respond to the questionnaires immediately.

The questionnaires were sent and distributed in SA on November 1991 to samples of science teachers, computer studies teachers and science trainers in Madinah city. 17 science teachers, 11 computer studies teachers and 3 science trainers were involved in this study (Table 7.5).

| **Type of sample** | **No.** |
|---|---|
| Science teacher | 17 |
| Computer studies teacher | 11 |
| Science trainer | 3 |

Table 7.5 Pilot study samples

Each questionnaire was accompanied by a letter explaining the purpose of the study and instructions for completion of the questionnaire. The attitudes and knowledge items in all of the questionnaires were listed in one thematic category. For each attitude item respondents were asked to tick one of the following choices: STRONGLY AGREE, AGREE, DISAGREE, STRONGLY DISAGREE or UNDECIDED. At the end of each page, they were asked to look back at the items and circle the difficult ones. (This was required only in the pilot study.) In addition to that, science teachers were asked to respond to 15 factual items about their classroom activity by ticking one of six choices: 1\D (almost every day), 1\W (once a week), 1\M (once a month), 1\T (once a term or less often) N (never) or UNDECIDED. The final page in each questionnaire included personal questions and space for extra suggestions. In addition, the science teacher trainers were asked to give opinions about any unsuitable item in all of the three questionnaires.

## 7.8 Analysis of the Pilot Study:

All copies were returned. the STQ and CSTQ data were analysed by the same statistical test, whilst STTQ data were used to justify items of the STTQ and also to confirm the STQ and CSTQ data.

The purpose of analysing the pilot study data was to select the most suitable items for use in the main study. If there is a great deal of agreement/disagreement among the population, then the item is a "fact" and it does not need further investigation, as it does not discriminate between different parts of the subject. The item is therefore be removed from the questionnaire.

A SPSS-PC non-parametric routine was used to analyse the STQ and CSTQ data by using the "Binomial test". The Binomial test is used with data that are binomially distributed, the hypothesis that probability $p$ of particular outcome is equal to some number is often of interest. If a population consists of categories of classes, then each observation ($X$) sampled from the population may take on one of two values. Depending on the category sampled, it is most convenient to denote each outcome as either 1 or 0. If the hypothesis is $H_0$: $p$ = $p_0$, the probabilities can be calculated for the various outcomes when it assume that $H_0$ is true. The Binomial test will tell whether it is acceptable to believe that the proportion with the hypothesised values of $p_0$ and 1-$p_0$. (See Norusis, 1990 and Siegel and Castellan, 1988). The "null" hypothesis was that 50% of the pilot population would agree with each item, while the other 50% would disagree. To find out the probability of agreement and disagreement with N cases observed, the following equation can be used:

$$p[Y=k]=\binom{N}{k}p^k q^{(N-k)} k=0,1,\ldots,N$$

Where $p$ = the proportion of observations expected where X = 1

$q$ = the proportion of observations expected where X = 0

(Source Siegel and Castellan, 1988).

$X$= 0 was denoted as the 'disagree' categories (SDA and DA), whilst $X$ =1 denoted as the 'agree' categories (SA and A). Choosing for example, item 2 in Table 7.6. 17 respondents responded to the item *(N=17)* , 3 disagreed *(k=3)*, while 14 agreed *(N-k=14)*. Thus the probability for the disagreement category ($X$=0) is:

$$p[Y=3]=\frac{(17!)}{(3!\,14!)}\left(\frac{1}{2}\right)^3\left(\frac{1}{2}\right)^{14}=0.013$$

The results indicates that this item has probability of greater than 0.01 of occurring by chance. Therefore, this item should be retained in the questionnaire because the Binomial distribution has shown that the two proportions (agree and disagree) have been drawn from a population with the hypothesised values of agree and disagree. In other words, the observed responses indicate no true difference between the response categories (agree and disagree) of the 17 respondents.

In contrast, the probability of item 1 Table 7.6 ($p$= 0.000) indicates very low probability of occurring by chance since there were 16 'agree' and no 'disagree'), therefore this item should be regarded as a 'fact' and thus rejected.

All items with low probability were rejected and removed from the questionnaires. Items with difficult wording were altered to make them simpler according to the trainers' suggestions. For example, item 7 from STQ, "*There is no benefit from the use of computers in science teaching, commensurate with their cost*", was changed to "*The benefit from the use of computer is not commensurate with their cost*".

Tables 7.6 to 7.11 show the pilot items for the scales and sections of STQ. They also show the response distribution and the results of the Binomial test for each item. According to the test results the decision was made for accepting or rejecting the items. The equivalent test and analysis for CSTQ were carried out, and its findings will be presented later in this chapter.

| No | Item | SDA‡ 1 | DA 2 | UD 3 | A 4 | SA 5 | Binomia 1 2-T p. | Decision |
|---|---|---|---|---|---|---|---|---|
| 1 | Computers are valuable tools that can be used to improve the quality of science teaching (+) | 0 | 0 | 1 | 11 | 5 | 0.000 | R* |
| 2 | I look forward to a time when computers are more widely used in science teaching (+) | 1 | 2 | 0 | 7 | 7 | 0.013 | |
| 3 | I would like to see computers in every school subject (+) | 1 | 1 | 0 | 9 | 5 | 0.004 | R |
| 4 | The use of computers in science teaching should be made compulsory immediately (+) | 0 | 4 | 1 | 6 | 5 | 0.119 | R** |
| 5 | The computer can enhance the learning of pupils in every science subject. | 3 | 2 | 0 | 6 | 5 | 0.210 | |
| 6 | If the computer is introduced into science teaching, then problems would arise as a result of that (-) | 0 | 1 | 0 | 9 | 6 | .0005 | R |
| 7 | There is no benefit from the use of computers in science teaching commensurate with their cost (-) | 5 | 6 | 0 | 3 | 2 | 0.210 | |
| 8 | Using computers in science teaching will improve the curriculum (-) | 0 | 2 | 0 | 9 | 5 | 0.004 | R |
| 9 | Computers bring more disadvantages than advantages to science teaching (-) | 4 | 1 | 0 | 3 | 8 | 0.210 | |
| 10 | Computers could make teaching chaotic (-) | 6 | 8 | 1 | 1 | 1 | 0.004 | R |
| 11 | The use of computers in science teaching would require large changes in science teaching methods (-) | 1 | 2 | 0 | 8 | 6 | 0.012 | |
| 12 | Science teaching is better without the use of computers (-) | 3 | 9 | 0 | 1 | 4 | 0.144 | |
| 13 | I almost never think about using a computer in my teaching (-) | 5 | 2 | 0 | 5 | 5 | 0.629 | |
| 14 | Computers will increase the amount of teacher-student interaction in the science classroom (-) | 1 | 10 | 0 | 3 | 3 | 0.332 | |
| 15 | We should rethink how our science curricula are organized so they make maximum use of computer technology (+) | 0 | 0 | 1 | 9 | 7 | 0.000 | R |

Sig. At P<0.01
‡ SDA= strongly disagree, DA= disagree, UD= undecided, A= agree and SA= strongly agree
* R= rejected items
** Item rejected for non-statistical reason

Table 7.6 Descriptive statistics for pilot items of the VALUE scale in the science teachers' questionnaire

Table 7.6 shows the VALUE scale pilot items. Six items were rejected because they did not achieve the probability level ($p$= 0.01) of the Binomial test. At the same time 4 was rejected although it did achieve the probability level because the word "immediately" confused the respondents, e.g., they were not sure whether that referred before or after planning and training for use. Finally, 8 items were retained to this scale.

The table indicates that almost all of the respondents were agreed to the items 1, 6 and 15. This may show that they had strong positive attitudes toward two aspects of the value of computers for science teaching; i.e items 1 and 15, and at the same time they were worried about the problems associated with the introduction of computers into science teaching; i.e item 6.

Table 7.7 shows BENEFIT scale pilot items. Three items were rejected because they did not achieve the probability level (*p*= 0.01), while item 9 was rejected although it did achieve the probability level because the expression "object" is unusual term in the SA teachers' society. Almost all of the sample agreed to items 7 and 8. As the result of these decisions, only five items were retained to this scale.

| No | Item | SDA# | DA | UD | A | SA | Binomial 2-T p. | Decision |
|---|---|---|---|---|---|---|---|---|
| 1 | Teaching science with computers would make the teaching easier (+) | 1 | 5 | 0 | 8 | 3 | 0.332 | |
| 2 | Introducing computers into science teaching would decrease the teacher's role (-) | 1 | 8 | 0 | 5 | 2 | 0.804 | |
| 3 | Using computers in science classrooms could weaken the teacher's control upon the students (-) | 2 | 8 | 0 | 5 | 2 | 0.629 | |
| 4 | Introducing computers into science teaching will decrease the teacher's workload (+) | 6 | 8 | 0 | 1 | 1 | 0.004 | R* |
| 5 | If the schools use more computers, they will need fewer teachers (-) | 3 | 8 | 2 | 2 | 2 | 0.119 | |
| 6 | Science teachers manage without computers, so computers are not really necessary (-) | 2 | 3 | 0 | 8 | 4 | 0.144 | |
| 7 | If I had a chance to use a computer I would use it (+) | 1 | 0 | 0 | 9 | 6 | 0.001 | R |
| 8 | Science teachers could introduce students to computers (+) | 0 | 1 | 2 | 10 | 3 | 0.002 | R |
| 9 | I object to all the attention being given to computers because it detracts from the real problems now faced by teachers (-) | 1 | 9 | 1 | 3 | 3 | 0.455 | R** |

Sig. At $p<0.01$
# SDA= strongly disagree, DA= disagree, UD= undecided, A= agree and SA= strongly agree
* R= rejected items
** item rejected for non-statistical reason

Table 7.7 Descriptive statistics for the pilot items of the BENEFIT scale in the science teachers' questionnaire

Although the TRAINING scale had 20 pilot-items in the pilot study, only six items were retained. The large number of rejected items can be seen as confirming the need to produce special instruments for the SA samples. Some items such as: 1, 2, 9, 11, 12, 16 and 19 were agreed by almost all of the sample. These items were measuring the attitudes to some aspects of training to use computers.

Item 15 was rejected because there is no overtime for teachers in the SA educational system. Therefore no benefit could be achieved from asking this item (Table 7.8).

| No | Item | SDA# | DA | UD | A | SA | Binomia l 2-T p. | Decision |
|---|---|---|---|---|---|---|---|---|
| 1 | I would like to learn how to use computers in my teaching (+) | 1 | 0 | 0 | 4 | 12 | 0.000 | R* |
| 2 | Science teachers should train to use computers in the classroom (+) | 1 | 0 | 0 | 4 | 12 | 0.000 | R |
| 3 | A computer training programme is necessary for every science teacher (+) | 0 | 4 | 2 | 4 | 7 | 0.119 | |
| 4 | A computer training programme is necessary for computer studies teachers only (-) | 6 | 9 | 0 | 1 | 1 | 0.002 | R |
| 5 | It is possible for science teachers to be trained to use computers by their computer teachers colleagues (+) | 1 | 1 | 0 | 11 | 4 | 0.002 | R |
| 6 | I would like my computer teacher colleague to train me to use computers in my teaching (+) | 5 | 5 | 0 | 6 | 1 | 0.629 | |
| 7 | A teacher of computer studies is not the best person to train science teachers to use computers (-) | 2 | 5 | 1 | 5 | 3 | 1.000 | |
| 8 | A science teacher has no time to train to use computers (-) | 2 | 1 | 0 | 4 | 10 | 0.004 | R |
| 9 | Science teachers will need a long time if they want to learn to use computers (-) | 2 | 0 | 0 | 9 | 6 | 0.000 | R |
| 10 | Probably I could never learn to use computers (-) | 8 | 6 | 0 | 2 | 0 | 0.004 | R |
| 11 | If there was a computer club in my school, I would help with it (+) | 0 | 0 | 2 | 11 | 4 | 0.000 | R |
| 12 | If there were computer courses for teachers, I would join them (+) | 0 | 0 | 0 | 9 | 7 | 0.000 | R |
| 13 | Science teachers should demand that they be taught how to use computers in their classroom (+) | 0 | 2 | 1 | 6 | 7 | 0.007 | R |
| 14 | I prefer to be trained in the use of computers inside my school (+) | 0 | 2 | 0 | 7 | 7 | 0.004 | R |
| 15 | Science teachers need overtime to be trained to use computers (-) | 2 | 2 | 0 | 7 | 5 | 0.077 | R** |
| 16 | Even if a science teacher knows how to use a computer in typing, he still requires to know how he can use it in the science classroom (-) | 0 | 0 | 1 | 10 | 6 | 0.000 | R |
| 17 | Science teachers must know a great deal about how computers work if they want to use them in science teaching (-) | 1 | 3 | 1 | 6 | 6 | 0.076 | |
| 18 | A computer studies teacher needs to know how to use computers in science teaching before he trains science teachers (-) | 1 | 5 | 0 | 6 | 5 | 0.332 | |
| 19 | The computer teacher needs to know how to use computers in teaching before he trains science teachers (-) | 0 | 0 | 0 | 8 | 8 | 0.000 | R |
| 20 | Only the computer studies teacher should use computers regularly in his teaching (-) | 5 | 8 | 0 | 2 | 2 | 0.05 | |

Sig. At p<0.01
# SDA= strongly disagree, DA= disagree, UD= undecided, A= agree and SA= strongly agree
* R= rejected items
** item rejected for non-statistical reason

Table 7.8 Descriptive statistics for the pilot items of the TRAINING scale in the science teachers' questionnaire

| No | Item | SDA# | DA | UD | A | SA | Binomial 2-T p. | Decision |
|---|---|---|---|---|---|---|---|---|
| 1 | Computers are as important to science pupils as text books in the classroom (+) | 0 | 5 | 1 | 5 | 5 | 0.301 | |
| 2 | Computers in science classrooms will require students to become active learners (+) | 0 | 1 | 1 | 10 | 5 | 0.001 | R |
| 3 | If we do not use computers in science teaching, our students will grow up illiterate and deprived of a basic science skill (+) | 1 | 8 | 2 | 2 | 3 | 0.424 | R** |
| 4 | Using computers in science classrooms will not improve pupils' positive attitudes toward sciences (-) | 2 | 11 | 0 | 0 | 4 | 0.049 | |
| 5 | Students who use computers will have more difficulty learning the basic science skills (-) | 5 | 9 | 0 | 1 | 1 | 0.004 | R |
| 6 | Computers will increase the amount of anxiety pupils' experience in the science classroom (-) | 1 | 10 | 1 | 3 | 1 | 0.119 | |
| 7 | Computers will improve science pupils' thinking (+) | 1 | 11 | 1 | 2 | 2 | 0.077 | |
| 8 | Computers will improve science pupils' problem-solving skills (+) | 1 | 2 | 0 | 12 | 2 | 0.012 | |
| 9 | Computers will improve science pupils' abilities (+) | 0 | 3 | 1 | 8 | 4 | 0.035 | |
| 10 | Using computers in science teaching will improve students' computer skills (+) | 0 | 0 | 1 | 8 | 8 | 0.000 | R |
| 11 | Computers would improve student's attitudes toward the science classroom (+) | 3 | 10 | 1 | 1 | 1 | 0.007 | R |
| 12 | Computers should be used throughout the subjects (-) | 1 | 1 | 0 | 10 | 5 | 0.004 | R |
| 13 | Computers will isolate students from one another (-) | 6 | 9 | 0 | 1 | 1 | 0.004 | R |
| 14 | Using computers in science teaching will improve students' attitudes toward computers (+) | 0 | 1 | 1 | 12 | 3 | 0.001 | R |
| 15 | Students do not like using the computers in the classroom (-) | 3 | 11 | 1 | 0 | 2 | 0.004 | R |
| 16 | Computers should not be a separate subject (+) | 0 | 1 | 1 | 8 | 6 | 0.000 | R |

Sig. At p<0.01
# SDA= strongly disagree, DA= disagree, UD= undecided, A= agree and SA= strongly agree
* R= rejected items
** Item rejected for non-statistical reason

Table 7.9 Descriptive statistics for the pilot items of the EFFECTIVE scale in the science teachers' questionnaire

Table 7.9 shows the pilot items of the EFFECTIVE scale. Six items were retained while ten items were rejected including item 3 which was rejected because "basic science skills" is too general a term. It was surprising that almost all the sample disagreed with item 11: "*Computers would improve student's attitudes toward the science classroom*", i.e. they saw no relation between the science classroom and computers. This could perhaps confirm their lack of knowledge about the possible contribution of computers to the science classroom. However, almost all of the sample were agreed with the positive items 2, 10, 12, 14 and 16, whilst they disagreed with the negative items 5, 13, and 15.

Because a major purpose of the preliminary study was aimed to estimate the knowledge of computers in the sample, Table 7.10 shows that eight items were selected for the KNOWLEDGE scale. Only two out of ten items were rejected. Item 3 seems excessively simple, while item 9 contains the words "you should" which perhaps led the respondents to disagree.

| No | Item | SDA# | DA | UD | A | SA | Binomial 2-T p. | Decision |
|---|---|---|---|---|---|---|---|---|
| 1 | Computers can be used as a private tutor (T)@ | 1 | 3 | 0 | 9 | 4 | 0.049 | |
| 2 | Computers are used to introduce a large amount of information for pupils. | 1 | 2 | 1 | 7 | 5 | 0.035 | |
| 3 | Computers can be used to store large amounts of information which can be used any time (T) | 0 | 0 | 0 | 7 | 10 | 0.000 | R |
| 4 | Computers have little application in science teaching (F) | 1 | 8 | 1 | 5 | 2 | 0.804 | |
| 5 | To use computers successfully, one needs to learn how to program (F) | 1 | 3 | 0 | 5 | 8 | 0.049 | |
| 6 | One of the computer weaknesses is that it is difficult to change the text when you type by computer (F) | 2 | 6 | 0 | 5 | 2 | 1.000 | |
| 7 | The use of PC is unrelated to the needs of the schools (F) | 1 | 6 | 0 | 5 | 5 | 0.629 | |
| 8 | The Saudi Arabian market has various examples of English software, but almost nothing in Arabic language (F) | 1 | 10 | 0 | 2 | 4 | 0.332 | |
| 9 | To use computers you should be specialized in computers (F) | 5 | 10 | 0 | 2 | 0 | 0.004 | R |
| 10 | Existing commercial software can be used in science teaching (T) | 0 | 5 | 2 | 4 | 6 | 0.302 | |

Sig. At p<0.01
# SDA= strongly disagree, DA= disagree, UD= undecided, A= agree and SA= strongly agree
* R= rejected items
@ T= True item, F= False item

Table 7.10 Descriptive statistics for the pilot items of the KNOWLEDGE section in the science teachers' questionnaire

On the evidence of their responses to the Activity items, science teachers were divided into two groups, the active group were those who responded 1\D; 1\W and 1\M whilst, the non-active group were those responded 1\T and N. Table 7.11 show that 7 items were rejected according to Binomial test criteria. That is to say, these items could not distinguish between teachers. However, the data show that the rejected items were these in which normal job determination was required officially such as: allowing pupils to participate; give short class test; etc.. The accepted items were those which related to computers and technology which relate to actions that are not required officially from the science teachers.

| No | Item Score | 1\D# 6 | 1\W 5 | 1\M 4 | 1\T 3 | N 2 | UD 1 | Binomial 2-T p. | Decision |
|---|---|---|---|---|---|---|---|---|---|
| 1 | I allow my students to do experiments by themselves. | 1 | 7 | 3 | 1 | 5 | 0 | 0.332 | |
| 2 | I use video in my teaching. | 0 | 5 | 7 | 3 | 2 | 0 | 0.144 | |
| 3 | I use an overhead projector in my class. | 3 | 5 | 4 | 2 | 3 | 0 | 0.144 | |
| 4 | I take my students on science trips. | 0 | 1 | 1 | 6 | 8 | 1 | 0.004 | R* |
| 5 | I deal with my students individually. | 9 | 6 | 0 | 1 | 1 | 0 | 0.004 | R |
| 6 | I allow my students to participate during their lesson. | 16 | 1 | 0 | 0 | 0 | 0 | 0.000 | R |
| 7 | I include discussion of TV science programmes in my teaching. | 7 | 3 | 2 | 3 | 1 | 1 | 0.144 | |
| 8 | I read educational computing articles to look for teaching ideas. | 2 | 1 | 6 | 2 | 6 | 0 | 1.000 | |
| 9 | I meet with computer teachers to discuss computer uses in teaching. | 1 | 3 | 0 | 3 | 10 | 0 | 0.050 | |
| 10 | I make personal visits to computer centres. | 0 | 0 | 3 | 5 | 8 | 0 | 0.021 | |
| 11 | I use the science laboratory in my teaching. | 8 | 7 | 2 | 0 | 0 | 0 | 0.000 | R |
| 12 | I ask the students to do experiments for their homework. | 2 | 2 | 11 | 1 | 1 | 0 | 0.002 | R |
| 13 | I ask my students to read extra books. | 3 | 3 | 8 | 0 | 2 | 0 | 0.004 | R |
| 14 | I advise my students to follow the developments in technology. | 5 | 2 | 4 | 5 | 0 | 0 | 0.210 | |
| 15 | I give my students short class tests. | 2 | 8 | 5 | 0 | 1 | 0 | 0.001 | R |

Sig. At $p<0.01$
* R= rejected item
# 1\D= once a day; 1\W= once a week; 1\T= once a term; N= never and UD= undecided

Table 7.11 Descriptive statistics of the pilot items of the **ACTIVITY** section in the science teachers' questionnaire

The ability of the retained items to distinguish between science teachers was one of the aims of this section and therefore reinforces the validity of the instruments.

The data of **CHARACTER** items revealed no difficulties in responding, therefore, all questions were retained.

## 7.9 The Final Administration of the Questionnaires:

After analysis of the STQ pilot data by Binomial test, the rejected items were removed from the final questionnaire, whilst the accepted items were retained and included in the final questionnaire. Table 7.12 summarizes the rejected and retained items in the STQ scales and sections explained in the previous section.

| Scale (section) | Rejected items for the Binomial test | Items rejected for non-statis. reasons | Retained items | No. of retained items |
|---|---|---|---|---|
| VALUE | 1, 3, 6, 8, 10, 15 | 4 | 2, 5, 7, 9, 11, 12, 13, 14 | 8 |
| BENEFIT | 4, 7, 8 | 9 | 1, 2, 3, 5, 6, | 5 |
| TRAINING | 1, 2, 4, 5, 8, 9, 10, 11, 12, 13, 14, 16, 19 | 15 | 3, 6, 7, 17, 18, 20 | 6 |
| EFFECTIVE | 2, 5, 10-16 | 3 | 1, 4, 6, 7, 8, 9 | 6 |
| KNOWLEDGE | 3, 9 | - | 1, 2, 4, 5, 6, 7, 8, 10 | 8 |
| ACTIVITY | 4, 5, 6, 11, 12, 13, 15 | - | 1, 2, 3, 7, 8, 9, 10, 14 | 8 |

Table 7.12 Scales and sections rejected items; retained items and number of retained items in each scale and section after pilot study analysis of the science teachers' questionnaire

Five items were added to the retained items in the final form of the science teachers' questionnaire. 3 items were added to the scale BENEFIT because few items were left in the scale after the analysis. Also, the additional items were intended to investigate whether science teachers believe in the benefits of computers only partially (i.e in some science subjects only, with specific pupils only). Two items were added to the scale TRAINING to find out in which place science teachers would prefer the training to take place and whether they would prefer a colleague to do the training (Table 7.10).

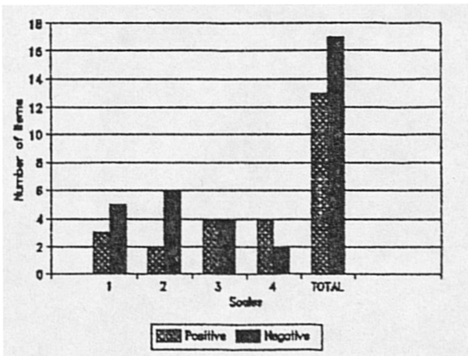
| Scale | New item |
|---|---|
| BENEFIT | Teaching science with the aid of computers would only make difficult topics easier (-) |
| BENEFIT | Teaching science with the aid of computers would make teaching easier for the most able pupils only (-) |
| BENEFIT | Teaching science with the aid of computers would make teaching easier for all pupils (+) |
| TRAINING | It is better to train science teachers in the schools rather than the Universities (-) |
| TRAINING | I would be willing for an expert from outside school to train me to use computers (+) |

Table 7.13 New items added in the final form of science teachers' questionnaire

All of the four scales include positive and negative items. The distribution of positive (favourable) and negative (unfavourable) items among the scales is given in Table 7.14 and Figure 7.1. The number of negative items is larger than the number of positive items within the questionnaire as a whole. This is because of the nature of the BENEFIT (and problems) scale where 6 negative items were located. The problems of using computers are negative, so it was thought that negative items could be more easily understood.

| Scale | Positive | Negative | Total |
|---|---|---|---|
| VALUE | 3 | 5 | 8 |
| BENEFIT | 2 | 6 | 8 |
| TRAINING | 4 | 4 | 8 |
| EFFECTIVE | 4 | 2 | 6 |
| TOTAL | 13 | 17 | 30 |

Table 7.14 Distribution of positive and negative items in the science teachers' questionnaire four scales



1,2,3,4 The scales respectively

Figure 7.1 Distribution of positive and negative items for the four scales of the science teachers' questionnaire

The positive items were: 1, 3, 4, 5, 7, 8, 14, 15, 22, 26, 28, 29 and 30. While the negative items were: 2, 6, 9, 10, 11, 12, 13, 16, 17, 18, 19, 20. 21, 23, 24, 25 and 27.

The CSTQ had the same operations of analysis, while the STTQ was analysed by using the three trainers' suggestions and comments. There were no specific criteria for rejecting STTQ pilot items, because of the very small sample size, but the sample suggestions were used as a guide for the STTQ final form.

Tables 7.15 to 7.17 show number of items in each scale and section used in the form of each type of questionnaire.

| Scale (Sec.) | VALUE | BENEFIT | TRAINING | EFFECTIVE | KNOWLEDGE | ACTIVITY | CHARACTER |
|---|---|---|---|---|---|---|---|
| No. of items | 8 | 8 | 8 | 6 | 8 | 8 | 8 |

Table 7.15 Number of items in each scale and section in the final form of the science teachers' questionnaire (STQ) after pilot study analysis

| Scale (Sec.) | VALUE | S.TRAINING | M.TRAINING | CHARACTER |
|---|---|---|---|---|
| No. of items | 7 | 13 | 5 | 8 |

Table 7.16 Number of items in each scale and section in the final form of the computer studies teachers' questionnaire (CSTQ) after pilot study analysis

| Scale (Sec.) | VALUE | S.TRAINING | TRAINING | EFFECTIVE | KNOWLEDGE | CHARACTER |
|---|---|---|---|---|---|---|
| No. of items | 7 | 5 | 6 | 6 | 8 | 8 |

Table 7.17 Number of items in each scale and section in the final form of the science teachers trainers' questionnaire (STTQ) after pilot study analysis

Four different thematic categories were used in the final questionnaires: SA (strongly agree), A (agree), DA (disagree) and SDA (strongly disagree) for the **ATTITUDE** scales; T (true), F (false) and DN (do not know) for **KNOWLEDGE** items; 1\D (once a day), 1\W (once a week), 1\M (once a month), 1\T (once a term or less often) and N (never) for **ACTIVITY** items; nominal boxes were used for **CHARACTER** items. The UNDECIDED column was omitted in the final questionnaires because few responses appeared under this column in the pilot results. For example in STQ the maximum UD response was 2 for N= 17, that is only 12 %. Moreover, the omitted "Not Sure" responses was found to be more reliable than responses in the UNDECIDED column. (Bame and Dugger (1989) claimed that "When analyzing the attitude scales, improved results were obtained if the "neutral" response was removed and counted as no response.) This meant that a four-point scale was used resulting in better statistical analysis" (p. 315).)

The bottom half of the final page in each questionnaire was used to invite respondents to give free format suggestions and recommendations on the subject of the use of computers in science teaching in SA.

Before the questionnaires were implemented in SA, they were given to a translation specialist at an SA University to compare the Arabic translation to the original version for each questionnaire in English and to ensure that each item retain its original meaning. He was also asked to make sure that the question did not contain any ambiguous expressions. This was confirmed (see Appendix D).

A copy of each questionnaire as used in the main fieldwork with its original English is attached in Appendix E.

## 7.10 Setting up the Interviews:

Chapter one indicated that the SA educational system is centralised by the Ministry of Education and all important decisions must come officially from the Ministry. Therefore, it was necessary to explore the officials' views on the introducing of computers into science teaching and to investigate current studies of issues on provision of computers.

The interview method was considered as the best way to explore the official views and attitudes toward the introduction of computers into science teaching. The interview was aimed at examining the Ministry policy for using computers in schools. To achieve these aims, only a very small number of persons with indepth information was required. Borg and Gall (1989) claimed that the interview is a popular and an effective method which can be used to assess views when the target sample is small.

On the basis of the preliminary and pilot field studies, an interview schedule was designed and refined for use with a senior officer in the SA Ministry of Education. The interview consisted of three main parts: the history of introducing computers in the secondary schools; the present use and facilities of computers; and future use of computers in the secondary schools.

For covering the three parts of the interview, a series of questions was scheduled about the following issues:

- the aims of introducing computers into SA secondary schools;
- the difficulties the Government had faced during the introduction: funds, training, hardware and software difficulties;

- computer benefit to the pupils and their attitudes from the official point of view;
- Government policy in the future: expansion of machines, expansion of uses, and funding budget;
- the officials' point of view on the use of computers in subject-teaching.

Although the interview was scheduled to cover the previous issues, it was decided to give the interviewer freedom to go further than answering the questions, to link any important issue raised during his speaking in connection with any of the matters need an investigation.

To give a clear idea of the time taken by the interview and the understandability of the questions, a trial interview with a professional educator who had previous experience in official posts taking the role of Government officer was made before the real interview took place.

# CHAPTER 8 : :

# RESEARCH DESIGN, ADMINISTRATION AND PRIMARY SCALE ANALYSES

This chapter describes the science teacher sample and their responses to the instruments. It also includes a description of the responses of the science advisors, who answered the same questionnaire. At the end of the chapter, an assessment of the responses of the science teachers' trainers is presented because in the STTQ they responded to very similar items to those used in the STQ.

## PART: A

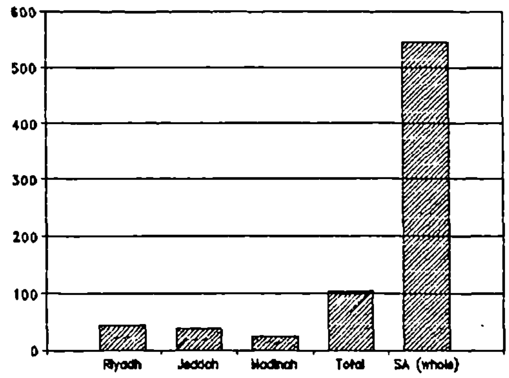
### 8.1 Choice and Description of the Sample:

The 1992 yearly report of the " Centre for Statistical Data & Educational Documentation " (CSDED) indicates that Saudi Arabia has 40 LEAs, responsible for 545 secondary schools and 9215 teachers. It also shows that there are 2013 science teachers for the four science subjects: Physics, Chemistry, Biology and Geology.

Moreover the report indicated that 122 secondary schools are based in three main cities: Riyadh; Jeddah and Madinah. Within these schools there are 607 science teachers (Table 8.1 and Figures 8.1 and 8.2).

| City | No. of secondary schools (%) | No. of science teachers (%) |
|---|---|---|
| **Riyadh** | 43 (7.9) | 242 (12) |
| **Jeddah** | 37 (6.7) | 253 (12.6) |
| **Madinah** | 25 (4.6) | 112 (5.6) |
| **Total** | 105(19.3) | 607 (30.2) |
| **SA (whole)** | 545 | 2013 |

Table 8.1 Descriptive statistics of secondary schools and science teachers by city, Source (CSDED)



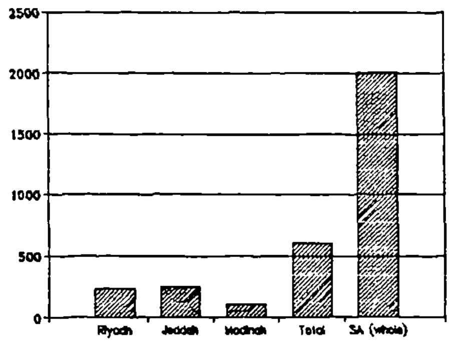




Figure 8.1 Distribution of secondary schools by city

Figure 8.2 Distribution of science teachers by city

The sample was chosen from the three main cities in SA: Riyadh; Jeddah and Madinah, because they have large populations, and represent different geographical regions (Riyadh is situated in the middle east, while Jeddah is in the west and Madinah is in the north).

The sample was identified as all science teachers in all the secondary schools in these cities which have computer equipment, including: 122 science teachers in Riyadh, 103 science teachers in Jeddah and 60 science teachers in Madinah (Table 8.2 and Figures 8.3 and 8.4).

| City | No. of schools | No. of science teachers | No. of schools with computers (%) | No. of science teachers (%) |
|---|---|---|---|---|
| Riyadh | 26 | 161 | 19 (73) | 122 (76) |
| Jeddah | 22 | 152 | 14 (64) | 103 (68) |
| Madinah | 10 | 85 | 7 (70) | 60 (71) |
| Total | 58 | 398 | 40 (69) | 285 (72) |

Table 8.2 Descriptive statistics for sample sources
Source (CSDED)

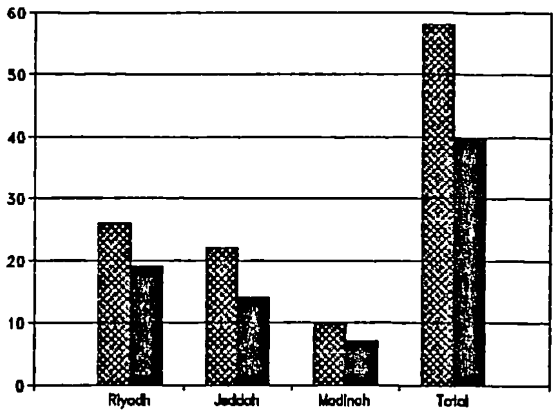



Figure 8.3 Distribution of original and selected schools

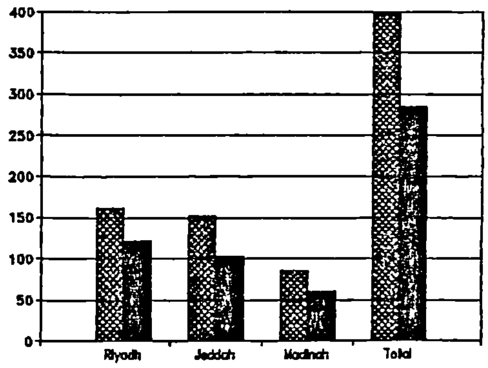



Figure 8.4 Distribution of original and selected science teachers

The questionnaires were distributed and collected or received in the period February and March 1992. The beginning of the second term was thought to be the most suitable time in SA because at this time teachers are free from examination pressures.

122 questionnaires were distributed in Riyadh starting on 8 February 1992. They were delivered to the five educational centres throughout the city, the schools' mailing service then delivered them to schools and

returned them to the centres. Reminder calls were made as necessary to schools whose envelopes had not been received on 16 February. By 19 Feb., 111 completed copies had been returned.

Because of the small number of schools in Madinah, 60 questionnaires were delivered and collected to and from schools personally in the period 22-26 February 1992. 55 completed copies were collected.

In Jeddah 103 questionnaires were used in the period 29 Feb.-18 March 1992. They were distributed and collected by the official post between Jeddah LEA and schools. Every school received the questionnaires accompanied by an official letter and form on which the school head was asked to inform the LEA about how many teachers completed the questionnaires, and to give reasons for any not completed. By 18 March, 100 copies had been returned.

Table 8.2 indicates that the highest rate of return of questionnaires was in Jeddah city where the questionnaires were distributed and collected via official channels, while the lowest was in Riyadh where they were delivered and collected through educational centres and schools mailings. 93% overall return is seen as a very high percentage response.

| City | No. of Whole sample | No. of returned copies (%) | No. of lost copies (%) |
|---|---|---|---|
| **Riyadh** | 122 | 111 (91) | 11 (9) |
| **Madinah** | 60 | 55 (92) | 5 (8) |
| **Jeddah** | 103 | 100 (97) | 3 (3) |
| **Total** | 285 | 266 (93) | 19 (7) |

Table 8.3 Descriptive statistics of science teachers' sample by city

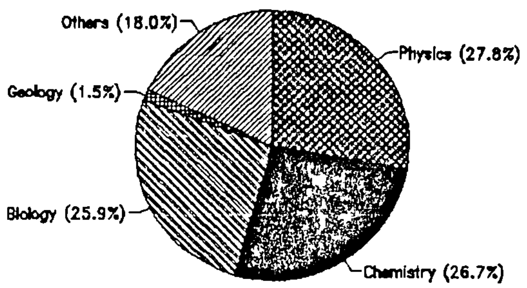
Because of the important role played by science advisors, all of the 19 science advisors in the three LEAs were invited to give their responses to the science teachers' questionnaire. 15 copies were completed and returned.

Tables 8.4 to 8.10 summarise the personal data supplied by the 266 science teachers and 15 science teacher advisors.

Table 8.4 and Figures 8.5 and 8.6 show that Physics, Chemistry and Biology were the main subjects taught by SA secondary school science teachers. Only four teachers taught Geology. One-fifth of the teachers' sample and one-third of the advisors' sample recorded (Others), which means pairs of subjects such as Physics and Chemistry, Biology and Geology, Chemistry and Biology and Chemistry or Geology.

| | ST | | STA | |
|---|---|---|---|---|
| | N=266 | % | N=15 | % |
| Physics | 74 | 27.8 | 2 | 13 |
| Chemistry | 71 | 26.7 | 4 | 27 |
| Biology | 69 | 25.9 | 3 | 20 |
| Geology | 4 | 1.5 | 1 | 6.7 |
| Others | 48 | 18.0 | 5 | 33.3 |

Table 8.4 Teaching subject of sample by group



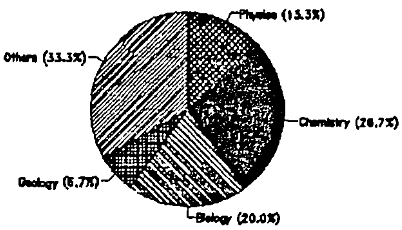




Figure 8.5 Distribution of subjects of science teachers' sample

Figure 8.6 Distribution of subjects of science advisors' sample

Table 8.4 indicates that few teachers had post-graduate degrees: those with MEd or MSc, or even Diploma (within the Others choice) were around one-fifth. The table also shows that a large number of teachers had no degree in education- those who had MSc or BSc. That means that two-fifth of the sample had no teaching methods background. Unlike science teachers, one-fifths of the science advisors had MEd.

| | Ed. degree | ST | | STA | |
|---|---|---|---|---|---|
| | | N=266 | % | N=14 | % |
| **MEd** | + | 4 | 1.5 | 3 | 20.0 |
| **MSc** | - | 5 | 1.9 | 0 | 0 |
| **BEd** | + | 137 | 51.5 | 7 | 46.7 |
| **BSc** | - | 103 | 38.7 | 3 | 20.0 |
| **Others** | ± | 17 | 6.4 | 1 | 6.7 |

+ Education degree qualifications, - No Education degree qualifications

Table 8.5 Qualification of sample by group

The experience data in Table 8.6 show that two-thirds of the STs had more than five years teaching experience, while all STAs had more than five years teaching experience.

| | ST | | STA | |
|---|---|---|---|---|
| | N=261 | % | N=14 | % |
| 0-5 | 95 | 36 | 0 | 0 |
| 6+ | 166 | 64 | 14 | 100 |

Table 8.6 Year of Experience of sample by group

Although use of computers is not officially required in science teaching, one-third of the ST sample and nearly half of the STA sample had PCs ( Table 8.7).

| | ST | | STA | |
|---|---|---|---|---|
| | N=264 | % | N=14 | % |
| **Yes** | 86 | 33 | 6 | 43 |
| **No** | 178 | 67 | 8 | 57 |

Table 8.7 Sample Ownership of PC by group

Only one-fifth of STs had computer experience. Table 8.8 suggests that less than this average was found in the case of STAs, but a $Chi^2$ test shows no significant difference ($p = 0.334$) between the levels of group experience. (Table 8.8).

| | ST | | STA | |
|---|---|---|---|---|
| | N=262 | % | N=13 | % |
| **Yes** | 58 | 22 | 2 | 15 |
| **No** | 204 | 78 | 11 | 85 |

Table 8.8 Number of sample by group who had Computer Experience

In line with the previous result, only about one-quarter of science teachers had attended computer courses. A higher average was found in the case of advisors. Among them, it was almost one-third of the sample (Table 8.9). Again the difference is not statistically significant.

| | ST | % | STA | |
|---|---|---|---|---|
| | N=262 | | N=14 | % |
| **Yes** | 62 | 24 | 5 | 36 |
| **No** | 200 | 76 | 9 | 64 |

Table 8.9 Number of sample by group who had attended Computer Courses

Table 8.10 shows the lack of courses related to the use of computer in teaching. Only 12 teachers and 3 advisors had attended such courses. Not surprisingly, the advisors had a significantly better attendance rate.

| | ST | | STA | |
|---|---|---|---|---|
| | N=256 | % | N=14 | % |
| **Yes** | 12 | 5 | 3 | 21 |
| **No** | 244 | 95 | 11 | 79 |

Table 8.10 Number of sample by group who had attended courses in use of computer in teaching

Table 8.11 summarizes the samples' knowledge of computers. The teachers group showed their highest level of success (77.4%) on item 2, and their lowest (22.6%) on item 6. As with the STs', STAs show their highest **correct** response score with item 2, whilst they show the lowest response with items 4 and 5 (26.7 %). This may suggest that item 2 is too simple. In half of the items (1, 2, 4 and 5) STs show slightly higher correct response scores than STAs, whilst STAs score slightly higher in the other items.

| No | Item | Group | F(%) | DN(%) | T(%) |
|---|---|---|---|---|---|
| 1 | Computers can be used as a private tutor (T) | ST | 113(42.50) | 43(16.2) | **108(40.6)** |
| | | STA | 7(46.7) | 2(13.3) | **6(40.0)** |
| 2 | Computers are used to introduce large amounts of information to pupils (T) | ST | 43(16.2) | 16(6) | **206(77.4)** |
| | | STA | 3(20.0) | 2(13.3) | **10(66.7)** |
| 3 | Computers have little application to science teaching (F) | ST | **116(43.6)** | 50(18.8) | 99(37.2) |
| | | STA | **9(60.0)** | 0(0) | 6(40) |
| 4 | To use a computer successfully, one needs to learn how to program (F) | ST | **73(27.4)** | 11(4.1) | 182(68.4) |
| | | STA | **4(26.7)** | 0(0) | 11(73.3) |
| 5 | One of the computer's weaknesses is that it is difficult to change the text when you type by computer (F) | ST | **82(30.8)** | 86(32.3) | 93(35.0) |
| | | STA | **4(26.7)** | 4(26.7) | 7(46.7) |
| 6 | The use of the PC is unrelated to the needs of the schools (F) | ST | **60(22.6)** | 87(32.7) | 112(42.1) |
| | | STA | **5(33.3)** | 4(26.7) | 6(40) |
| 7 | The Saudi Arabian market has various examples of English software, but almost nothing in the Arabic language (F) | ST | **67(25.2)** | 88(33.1) | 108(40.6) |
| | | STA | **8(53.3)** | 5(33.3) | 2(13.3) |
| 8 | Existing commercial software can be used in science teaching (T) | ST | 96(36.1) | 86(32.3) | **83(31.2)** |
| | | STA | 4(26.7) | 6(40) | **5(33.3)** |

Table 8.11 Descriptive statistics for "knowledge of computer" by group for the samples of STs and STAs

The table indicates that more than half of each of the two samples could not achieve the correct answer to most of the eight computer knowledge items. Even with items testing basic knowledge of computer use such as item 1 "*Computers can be used as a private tutor*", the majority failed to give the correct response.

Because STAs have no involvement with classroom activities, they were not given the activity items, thus only STs' data are presented in Table 8.12. On the basis of their replies, respondents were divided into two groups for each item. The active group were those who responded 1\D (once a day), 1\W (once a week) and 1\M (once a month), whilst, the non-active group were those responding 1\T (once a term or less often) and N (never).

Table 8.12 indicates that the number of teachers in the active group is greater than that in the non-active group for four of the eight items: 1, 2, 5 and 8. It can be seen that the number in the non-active group is always more than the number of the active group in the case of items mentioning computers, i.e items 4, 6 and 7. That seems to confirm the results of the preliminary study which indicated lack of computer literacy among SA secondary school subject teachers.

| No | Items | N | Active (%) | Non-active (%) |
|---|---|---|---|---|
| 1 | I allow my students to do experiments by themselves. | 263 | 190 (72) | 73 (28) |
| 2 | I use video in my teaching. | 259 | 144 (56) | 115 (44) |
| 3 | I use an overhead projector in my class. | 261 | 122 (47) | 139 (53) |
| 4 | I make personal visits to computer centres. | 265 | 65 (25) | 200 (75) |
| 5 | I include discussion of TV science programmes in my teaching. | 261 | 169 (65) | 92 (35) |
| 6 | I read educational computing articles to look for teaching ideas. | 256 | 85 (33) | 171 (67) |
| 7 | I meet with computer teachers to discuss computer uses in teaching. | 254 | 105 (41) | 149 (59) |
| 8 | I advise my students to follow the developments in technology. | 262 | 215 (82) | 47 (18) |

Table 8.12. Descriptive statistics for science teachers' sample activities

It is obvious that the ACTIVITY items shown in Table 8.12 divide the science teachers' sample into two approximately equal groups according to their classroom activity. The percentage of each group was closest to each other for five items, 2, 3, 5, 6 and 7. However, Figure 8.7 shows that the data of all items could make almost similar areas for each group, which means each group covered half of the whole area of expected responses.

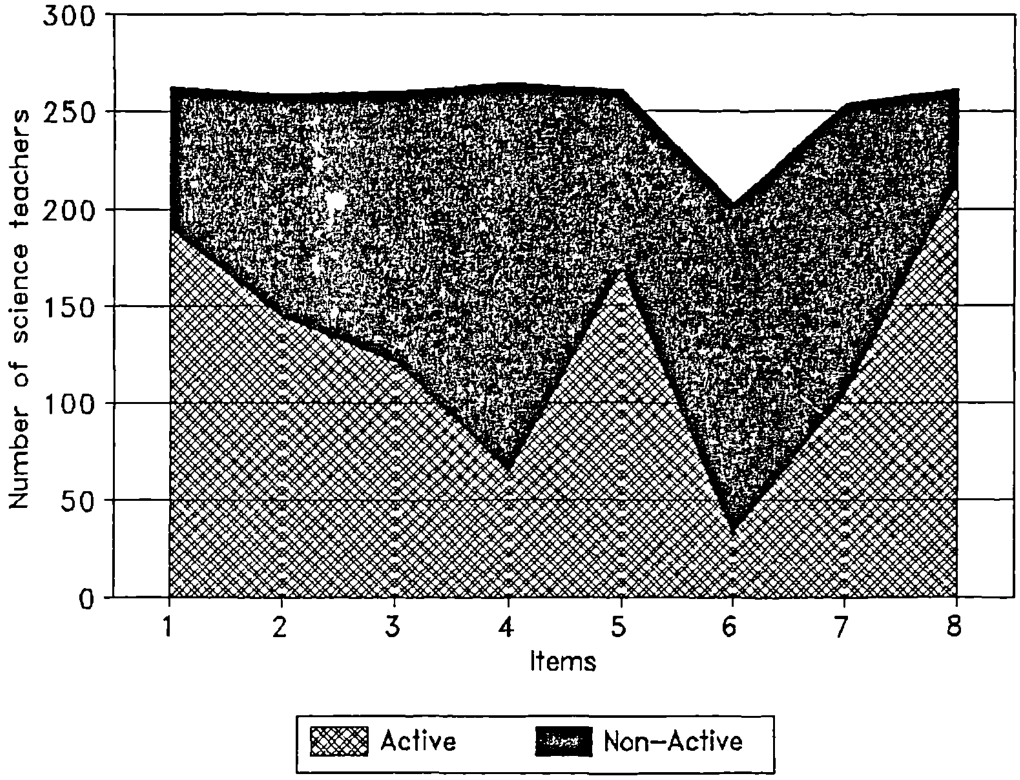



Figure 8.7 Area distribution for active and non-active groups in the science teachers' data

## 8.2 Scoring the Responses:

To prepare the data for computer analysis it was convenient to score each response in one system, scoring for each part of the questionnaire. The Attitudes items were scored as: SA=4, A=3, DA=2 and SDA=1 for the positive items and SA=1, A=2, DA=3 and SDA=4 for negative items. All missing responses were scored as mid point (2.5).

The knowledge items were scored as: True=2 and False or Do Not Know= 1, for the items, 1, 2 and 8, because they are true items; and

False=2 and True and Do Not Know= 1, for the items, 3, 4, 5, 6, and 7, because they are false items. All missing responses were scored as mid point (1).

The Activity items were scored as 2 for the active group and 1 for the non-active group. All missing responses were scored as mid point (1.5).

Generally, few missing values were found. In the majority of the subjects there were no missing values at all. Maximum missing values were 10 cases (3.8%) per item.

## 8.3 Confirming the Scales:

The scales of the science teachers' questionnaire were developed from the preliminary study and were used in the pilot study as well. 30 attitude items in the STQ were used in the main study divided into the same four previous scales. The scales are:

- Attitudes to the value of computers for science teaching (**VALUE**), eight items: 4, 5, 10, 16, 20, 25, 27, 29;
- Attitudes to the benefits and problems which they might see in the use of computer in their classrooms (**BENEFIT**), eight items: 2, 6, 9, 13, 17, 22, 23, 28;

. Attitudes toward training to use computer in their teaching (**TRAINING**), eight items: 3, 7, 11, 14, 18, 21, 24,26, and

. Attitudes toward the effectiveness or otherwise of pupils' use of computers (**EFFECTIVE**), six items: 1, 8, 12, 15, 19, and 30.

Tables 8.13 to 8.16 display summaries of statistical description for each scale in the STQ using data supplied by 266 science teachers and 15 advisors. The tables include the mean and standard deviation for each item and score mean and score standard deviation for both STs and STAs.

Table 8.13 indicates that both STs and STAs scored higher than the item-mid point for 7 items of the scale VALUE. However the STAs show greater but not significantly greater differences between means for five items.

| No | Item | | ST N=266 | STA N=15 |
|---|---|---|---|---|
| 4 | Computers will increase the amount of teacher-student interaction in the science classroom. | M<br>SD | 3.07<br>0.768 | 2.93<br>0.799 |
| 5 | I look forward to a time when computers are more widely used in science teaching | M*<br>SD | 3.34<br>0.690 | 3.00<br>0.845 |
| 10 | Computers bring more disadvantages than advantages to science teaching. | M<br>SD | 2.85<br>0.800 | 3.10<br>0.930 |
| 16 | There is no benefit from the use of computers in science teaching commensurate with their cost. | M<br>SD | 2.57<br>0.791 | 2.73<br>1.10 |
| 20 | The use of computers in science teaching would require large changes in science teaching methods. | M<br>SD | 1.93<br>0.745 | 2.07<br>0.884 |
| 25 | Science teaching is better without the use of computers. | M<br>SD | 2.74<br>0.771 | 2.87<br>0.743 |
| 27 | I almost never think about using a computer in my teaching. | M<br>SD | 2.57<br>0.786 | 2.80<br>0.676 |
| 29 | Computers can enhance the learning of pupils in every science subject. | M<br>SD | 2.98<br>0.743 | 2.73<br>0.961 |

*M= Mean, SD= Standard Deviation

Scale mid-point= 20, item mid-point= 2.5

Score mean: ST= 22.08, STA= 22.24

Score SD : ST= 6.09, STA= 6.94

Table 8.13 Descriptive statistics of Means and Standard Deviation for the items of the **VALUE** scale by group

Table 8.14 shows that above mid point scores were achieved on 7 items of the scale BENEFIT by both STs and STAs. For five items STs achieved a higher item-mean, but the two groups had approximately equal score means (Table 8.14).

| No | Item | | ST N=266 | STA N=15 |
|---|---|---|---|---|
| 2 | Introducing computers into science teaching would decrease the teacher's role. | M<br>SD | 2.82<br>0.741 | 2.53<br>0.834 |
| 6 | Science teachers manage without computers, so computers are not really necessary. | M<br>SD | 2.32<br>0.746 | 2.27<br>0.884 |
| 9 | Teaching science with the aid of computers would only make difficult topics easier. | M<br>SD | 2.50<br>0.729 | 2.87<br>0.743 |
| 13 | Teaching science with the aid of computers would make teaching easier for the most able pupils only. | M<br>SD | 2.62<br>0.829 | 2.73<br>0.594 |
| 17 | If the schools use more computers, they will need fewer teachers. | M<br>SD | 2.77<br>0.790 | 3.07<br>0.961 |
| 22 | Teaching science with the aid of computers would make teaching easier for all pupils. | M<br>SD | 2.90<br>0.732 | 2.63<br>0.896 |
| 23 | Using computers in science classrooms could weaken the teacher's control of the students. | M<br>SD | 2.70<br>0.804 | 2.87<br>0.516 |
| 28 | Teaching science with the aid of computers would make teaching easier. | M*<br>SD | 3.02<br>0.745 | 2.77<br>0.863 |

* M= Mean, SD= Standard Deviation

Scale mid-point= 20, item mid-point= 2.5

Score mean: ST= 21.68, STA=21.76

Score SD : ST= 6.12, STA=6.29

Table 8.14 Descriptive statistics of Means and Standard Deviation for the items of the BENEFIT scale by group

Unlike the previous two scales, only about half of the scores in the scale TRAINING achieved the item mid-point. On half of the items STAs obtained a slightly greater mean than STs, while the STs obtained slightly mean in the other half of the items (Table 8.15).

| No | Item | | ST N=266 | STA N=15 |
|---|---|---|---|---|
| 3 | A computer training programme should be compulsory for every science teacher. | M* | 3.07 | 3.13 |
| | | SD | 0.835 | 0.634 |
| 14 | I would like my computer studies colleague to train me to use a computer in my teaching. | M | 3.01 | 3.07 |
| | | SD | 0.783 | 0.799 |
| 24 | A teacher of computer studies is not the best person to train science teachers to use computers. | M | 2.26 | 2.47 |
| | | SD | 0.741 | 0.640 |
| 7 | It is better to train science teachers in the schools rather than in Universities. | M | 2.75 | 2.33 |
| | | SD | 0.916 | 0.817 |
| 11 | Science teachers must know a great deal about how computers work if they want to use them in science teaching. | M | 1.63 | 1.43 |
| | | SD | 0.742 | 0.563 |
| 18 | A computer studies teacher needs to know how to use computers in science teaching before he trains science teachers. | M | 1.55 | 1.47 |
| | | SD | 0.684 | 0.916 |
| 21 | Only the computer studies teacher should use computers regularly in his teaching. | M | 2.76 | 3.07 |
| | | SD | 0.918 | 1.03 |
| 26 | I would be willing for an expert from outside school to train me to use computers. | M | 3.35 | 3.53 |
| | | SD | 0.660 | 0.516 |

* M= Mean, SD= Standard Deviation

Scale mid-point= 20, item mid-point= 2.5

Score mean: ST= 20.04, STA=20.96

Score SD : ST= 6.28, STA=5.92

Table 8.15 Descriptive statistics of Means and Standard Deviation for the items of the TRAINING scale by group

Table 8.16 shows that all item scores on the EFFECTIVE scale reached the item mid-point for both of STs and STAs. The total score means were very nearly equal for the two groups.

| No | Item | | ST N=266 | STA N=15 |
|---|---|---|---|---|
| 1 | Computers are as important to science pupils as text books in the classroom. | M | 2.75 | 2.43 |
| | | SD | 0.804 | 0.623 |
| 12 | Using computers in the science classroom will not improve pupils' positive attitudes towards the sciences. | M | 2.90 | 3.00 |
| | | SD | 0.786 | 0.378 |
| 19 | Computers will increase the amount of anxiety pupils experience in the science classroom. | M | 2.84 | 3.27 |
| | | SD | 0.707 | 0.458 |
| 30 | Computers will improve science pupils' thinking. | M | 3.13 | 3.00 |
| | | SD | 0.708 | 0.756 |
| 8 | Computers will improve science pupils' problem-solving skills. | M | 3.07 | 3.03 |
| | | SD | 0.629 | 0.896 |
| 15 | Computers will improve science pupils' abilities. | M | 2.82 | 2.47 |
| | | SD | 0.709 | 0.516 |

* M= Mean, SD= Standard Deviation

Scale mid-point= 15, item mid-point= 2.5

Score Mean: ST= 17.52, STA=17.22

Score SD : ST= 4.34, STA=3.63

Table 8.16 Descriptive statistics of Means and Standard Deviation for the items of the **EFFECTIVE** scale by group

Tables 8.13-8.16 indicates that the score-mean of all scales were over their scale mid-points for both ST and STA samples. In the scales, VALUE, BENEFIT AND EFFECTIVE scores on almost all items were over the item mid-point. On the three scales, only two items among STs and three items among STAs scored below the item mid-point. In contrast, Table 8.15 shows that for the scale TRAINING about half of the items, (three among STs and four among STAs) scored lower than the item mid-point. There will be more discussion of this point in chapter 11.

## 8.4 Scale Reliability:

The data supplied by 266 science teachers were used to estimate the sensitivity and the internal consistency reliability of the four scales of STQ.

The sensitivity of an attitude test or questionnaire is its ability to discriminate between levels of attitude. The sensitivity of the scales is related to the range of scale scores obtained by the respondents; the wider the range of scores, the higher is the sensitivity of the scale (Moore, 1984).

Table 8.17 shows that the scales of the STQ gave a wide range of scores, more than four-fifths of VALUE, BENEFIT and EFFECTIVE scales were covered by the responses of 281 STs, whilst more than a half of TRAINING scale were covered. However, the range covered by all scales (SUM) was from 52 to 106, 60% of the possible range. This would be wider as a percentage of the scale span without the TRAINING scale. The mean of the scale SUM is 81.60, near to the scale mean of 75.

| Scale name | No. of items | Possible range of scales | | | Observed range of scales | | Mean score | Scale variance |
|---|---|---|---|---|---|---|---|---|
| | | Min. | Mid-point | Max. | Min. | Max. | | |
| VALUE | 8 | 8 | 20 | 32 | 11 | 31 | 22.08 | 1.43 |
| BENEFIT | 8 | 8 | 20 | 32 | 12 | 31 | 21.66 | 0.41 |
| TRAINING | 8 | 8 | 20 | 32 | 14 | 27 | 20.37 | 3.56 |
| EFFECTIVE | 6 | 6 | 15 | 24 | 10 | 24 | 17.50 | 0.14 |
| SUM | 30 | 30 | 75 | 120 | 52 | 106 | 81.60 | 17 |

Table 8.17 Possible and observed ranges and score means for the four scales of science teachers' questionnaire. Description of scales SUM also shown

The internal consistency Alpha and the equal length Spearman-Brown probability ($R_{SB}$) were calculated.

The $R_{SB}$ estimates the reliability of a questionnaire of items as long as the one for which we know is a self-correlation. In that case estimates of reliability arise from the relationships between items and overall construct. The split-half method works on the basis that there is a high degree of equivalence between questionnaire items, so much so that it is possible to separate them into two halves which perform similarly. However, one weakness of this method is that a questionnaire can be split into halves in many ways, and each split half could yield a somewhat different estimate of questionnaire reliability.

Because of the dissatisfaction with the split-half methods, Kuder-Richardson (KR) and later Cronbach developed alternative ways of estimating scale reliability. The Cronbach alpha reliability is used to estimate the degree of consistency within a questionnaire. One weakness of this method is it is an estimate and generally only offers a lower bound for the true value. Youngman (1979) suggested lengthening a test tends to increase the associated alpha which masks the effect of unsuitable items. The effect of individual items can be assessed by comparing alpha values with and without each item (complementary alpha). If the alpha value increases by dropping an item then that item must be disturbing the reliability.

The reliability of the questionnaire was estimated as 0.712, 0.646, 0.052, 0.644 and 0.798 by the internal consistency Alpha of the scales VALUE, BENEFIT, TRAINING, EFFECTIVE and SUM. Spearman-Brown reliability were close to the alpha values for all scales except TRAINING scale. They were recorded as; 0.719, 0.621, 0.162, 0.620 and 0.811 for the scales respectively. (Table 8.18).

| Scale name | No. of items | $\alpha$ | RSB |
|---|---|---|---|
| VALUE | 8 | 0.712 | 0.719 |
| BENEFIT | 8 | 0.646 | 0.621 |
| TRAINING | 8 | 0.052 | 0.162 |
| EFFECT | 6 | 0.644 | 0.620 |
| SUM | 30 | 0.828 | 0.811 |

Table 8.18 Scales reliability by using alpha and Spearman-Brown. The reliability of the whole of STQ (SUM) also shown.

Each of the three scales (VALUE, BENEFIT AND EFFECTIVE) has an acceptable reliability from 0.620 for the scale EFFECTIVE to 0.719 for the scale VALUE with both of the two reliability tests. Alpha was recorded as 0.828 for the whole questionnaire with TRAINING scale and even higher, 0.850, without this scale. The TRAINING scale is unreliable by both tests.

The complementary-alpha values given in Table 8.19 indicate that all of the three scales have a satisfactory make-up of items. For only one item in the scale VALUE and one item in the scale BENEFIT was the complementary-alpha less than the full scale alpha value, but the difference is small. In the TRAINING scale, the complementary-alpha show that little improvement in scale reliability could be achieved by removing any items. It was concluded that the items are not sufficiently homogeneous to form a scale. Consequently, it was decided to deal with each item individually.

| Item | Item variance | Variance of com. scale | complementary alpha | |
|---|---|---|---|---|
| 4 | 59 | 9.57 | 0.672 | **VALUE** scale (8 items) |
| 5 | 0.48 | 9.63 | 661 | $\alpha$=0.712 |
| 10 | 64 | 8.96 | 645 | RSB= 0.719 |
| 16 | 63 | 10.12 | 702 | |
| 20 | 56 | 12.06 | 771 | |
| 25 | 59 | 8.93 | 637 | |
| 27 | 62 | 9.53 | 673 | |
| 29 | 55 | 9.89 | 683 | |
| **Total** | 0.179 | ---- | 0.712 | |
| 2 | 55 | 8.74 | 615 | |
| 6 | 56 | 8.58 | 606 | **BENEFIT** scale (8 items) |
| 9 | 53 | 9.45 | 654 | $\alpha$=0.646 |

| | | | | |
|---|---|---|---|---|
| 13 | 69 | 8.06 | 588 | RSB= 0.621 |
| 17 | 62 | 8.70 | 623 | |
| 22 | 54 | 8.81 | 617 | |
| 23 | 65 | 8.41 | 606 | |
| 28 | 0.56 | 8.84 | 0.622 | |
| **Total** | 0.051 | ---- | 0.646 | |
| 3 | 0.55 | 4.53 | 0.060 | |
| 7 | 84 | 3.98 | -052 | **TRAINING** scale (8 items) |
| 11 | 55 | 4.82 | 091 | α=0.052 |
| 14 | 69 | 4.03 | -102 | RSB= 0.162 |
| 18 | 47 | 5.12 | 136 | |
| 21 | 84 | 4.64 | 057 | |
| 24 | 65 | 4.44 | -001 | |
| 26 | 44 | 5.11 | 127 | |
| **Total** | 0.45 | ---- | 0.052 | |
| 1 | 0.65 | 4.81 | 0.596 | |
| 8 | 40 | 5.28 | 594 | **EFFECTIVE** scale (6 items) |
| 12 | 62 | 4.91 | 602 | α=0.644 |
| 15 | 50 | 5.20 | 610 | RSB= 0.620 |
| 19 | 50 | 5.40 | 634 | |
| 30 | 50 | 4.85 | 564 | |
| **Total** | 0.02 | ---- | 0.644 | |

Table 8.19 Item and scale variances together with complementary-alpha values for the four science teachers' questionnaire scales (30 items)

The complementary-alphas for the three scales individually are less than the whole questionnaire alpha, whilst removing the TRAINING scale can give some improvement to the questionnaire reliability (from 0.828 to 0.850). Thus, additional support for the omission of the scale is obtained here (Table 8.20).

| Scale | Scale variance | Variance of com. scale | Complementary alpha | |
|---|---|---|---|---|
| VALUE | 0.179 | 41.090 | 0.665 | Questionnaire (Total) |
| BENEFIT | 051 | 46.304 | 720 | α=0.828 |
| TRAINING | 446 | 69.126 | 850 | RSB= 0.620 |
| EFFECTIVE | 023 | 54.161 | 714 | |
| Total | 4.251 | 4.251 | 0.828 | |

Table 8.20 Scale variances together with complementary-alpha values for the four science teachers' questionnaire scales and Total (30 items)

It can be concluded that the scales VALUE, BENEFIT and EFFECTIVE can be used to probe similar dimensions of science teachers' attitudes to the use of computers. Reliability data show that the eight TRAINING items do not constitute a scale and that moreover the scale, if adopted, does not measure in the same region of teachers' attitudes. The reason for the unreliability of the TRAINING items may be associated with the different aspects this scale measured. For example, item 21 was, "*Only the computer studies teacher should use computers regularly in his teaching*", but the item 26 was "*I would be willing for an expert from outside school to train me to use computers*".

## 8.5 Factor Analysis Validity:

The spss/pc+ Factor Analysis routine was used to reestimate the validity of the STQ 30 attitude items. Factor analysis is a common validity test used to identify a relatively small number of factors that can be used to represent relationships among sets of many interrelated variables. The initial[1] statistics shown in Table 8.21 suggested seven main factors because only factors that account for variance greater than 1 should be included (Norusis, 1990). More than one-fifth of the questionnaire variance was loaded in the first factor.

| Factor | Eigenvalue | Pct of Var | Cum Pct |
|---|---|---|---|
| 1 | 6.70932 | 22.4 | 22.4 |
| 2 | 2.73630 | 9.1 | 31.5 |
| 3 | 1.68908 | 5.6 | 37.1 |
| 4 | 1.42013 | 4.7 | 41.8 |
| 5 | 1.29397 | 4.3 | 46.2 |
| 6 | 1.12948 | 3.8 | 49.9 |
| 7 | 1.05815 | 3.5 | 53.5 |
| 8 | .97765 | 3.3 | 56.7 |
| 9 | .96472 | 3.2 | 59.9 |
| 10 | .90634 | 3.0 | 63.0 |

Table 8.21 Initial statistics for science teachers' questionnaire 30 items including, factors, eigenvalue, percentage of total variance and total variance

[1]. A complete factor analysis statistics is located in Appendix F.

Very few items were loaded in factors five, six and seven, suggesting that the use of only four factors would be most suitable and give more meaningful factors for the 30 items. The four factors accounted for 41.8% of the total questionnaire variance (Table 8.21). All items except one were loaded above or equal to 0.40 in one of the first four factors, and therefore accepted. If an item was loaded in more than one factor, the highest loading determined its inclusion (see Appendix F).

Factor 1 had loadings from 19 items, accounting for 22.4 % of the total variance, with an eigenvalue of 6.71. The highest loading of 0.73 was on item 25, "*Science teaching is better without the use of computers*", whilst the lowest loading of 0.30 was on item 2, "*Introducing computers into science teaching would decrease the teacher's role*". It is obvious that almost all VALUE and EFFECTIVE items were loaded in this factor. The factor, therefore, was labelled: Attitudes to the importance of computers for science teaching and pupils (**IMPORTANT**).

4 items were loaded in factor 2, accounting for 9.1 % of the total variance, with an eigenvalue of 2.74. The highest loading of 0.45 was on item 9, "*Teaching science with the aid of computers would only make difficult topics easier*", whilst the lowest loading of 0.41 was on item 20, "*The use of computers in science teaching would require large changes in science teaching methods*". Three items of this factor were found in the scale BENEFIT (and problems), but all these items concerned problems rather than benefit. This factor, therefore, was labelled: Attitudes to the

problems which teachers see in the use of computers in their classrooms (PROBLEMS).

4 items were also loaded in factor 3, accounting for 5.6 % of the total variance, with an eigenvalue of 1.69. The highest loading of 0.69 was on item 14, "*I would like my computer studies colleague to train me to use a computer in my teaching*", whilst the lowest loading of 0.40 was for item 26 "*I would be willing for an expert from outside school to train me to use computers*".

Only 3 items were loaded in factor 4, accounting for 4.7 % of the total variance, with an eigenvalue of 1.42. The highest loading of 0.56 was on item 11, "*Science teachers must know a great deal about how computers work if they want to use them in science teaching*" and the lowest loading of 0.42 was on item 21 "*Only the computer studies teacher should use computers regularly in his teaching*".

All items of the last two factors were found in the scale TRAINING. They were therefore labelled the same as TRAINING : Attitudes toward training to use computers in their teaching, but factor 3 was named as **TRAINING1** and factor 4 named **TRAINING2**. The following table shows each factor and its items.

| **Factor** | **IMPORTANT** | **PROBLEM** | **TRAINING1** | **TRAINING2** |
|---|---|---|---|---|
| **Items No.** | 1-6, 8, 10, 12, 13, 15, 16, 19, 22, 25, 27-30 | 9, 17,20, 23 | 7, 14,24, 26 | 11, 18, 21 |

Table 8.22 The science teachers' questionnaire four factors and items loaded for each factor

The four factors were plotted according to their loading in two factors 1 and 2 or 3 and 4. Figures 8.8 a and b show loading plots of the factor using Factors 1 and 2 as the coordinates in Figure 8.8a and using Factors 3 and 4 as the coordinates in Figure 8.8b. The IMPORTANT Factor items shown in Figure 8.8a indicate a clusters of items around the factor axis, the items at the end of the axis seem to have high loading on only this Factor (Norusis, 1990), e.g, items, 8, 29, 30, 22, 27, etc., whilst items near to the origin of the plot have low loading on both factors, such as items 2, 7, 24, etc.. The axis also includes items 11 and 18 because each of the two items has high loading in this factor (see Appendix F), but at the same time, they have a higher loading in TRAINING2 factor, therefore they appeared in again in the TRAINING2 axis with item 21 (Figure 8.8b). A clear axis appeared for the factor TRAINING1 items (7, 14, 24, 26), which could also include item 2 because it has a high loading in this factor (Figure 8.8b).

**Horizontal Factor 1 Vertical Factor 2**

```
                   *
                   *
                   *
           112018 9  17  23
                   *     1927
                24 *    216   10
                   *   21   6
                   *        4   25
*************************************
                   * 7
                   *        22
                   *14      829
                   *   2615 330
                   *
```

**Horizontal Factor 3 Vertical Factor 4**

```
                 *
                 *
                11
            18   *
                 *
            13   6
               8 *   1       7
            1230 *27        14
***********************************
             92220      24
          16     *15 2
        26      23
                 *
                2117
                 *
                 *
```

<u>Figure 8.8a</u> Factor loading plots for the items using factors 1 and 2 as the coordinates

<u>Figure 8.8b</u> Factor loading plots for the items using factors 3 and 4 as the coordinates

The four factors were treated as scales and each item was treated according to its factor. Appendix F shows the complementary alpha for each item to its factor.

No significant improvement could be achieved by removing any of items in the IMPORTANT factor, although removing item 2 could increase the alpha value of the factor from 0.879 to 0.882. For this reason all items were retained in the factor.

The alpha reliability of the factor PROBLEM recorded 0.391, which can be increased to 0.416 if item 20 is removed. Because there are few items in this factor, it was decided to retain the item in the factor.

Unlike the two previous factors, small alpha values were recorded for the factors: TRAINING1 and TRAINING2. However, the items in each factor were too few to remove any of them, therefore these items must be analysed separately.

It can be concluded that factor analysis loaded the 30 items of STQ into four factors: IMPORTANT (19), PROBLEM (4), TRAINING1 (4) and TRAINING2 (3). There were close correspondence between VALUE, BENEFIT, and EFFECTIVE scales.

TRAINING items do not belong to any scale. This would confirm the previous findings regarding the scale and the decision was made to deal with TRAINING items individually and with the three scales as groups.

## PART B:

### 8.6 Description of Science Trainers' Sample and Scales:

The important role played by science teacher trainers (STT) in pre- and in-service science teacher training and in the decisions which can made by them for SA science teaching, made it very important to investigate their knowledge and attitudes in preliminary, pilot and main studies toward introducing computers and using them for science teaching.

All science teacher trainers in all SA Universities were involved in this study: 7 trainers at King Saud University at Riyadh (KSU1), 6 trainers at King Saud University branch at Abha (KSU2), 5 trainers at Om Al-Qura University at Makkah (OQU1), 1 trainer at Om Al-Qura University branch at Tayef (OQU2), 4 trainers at King Abdul Aziz University at Madinah (KAU) and 2 trainers at King Faisal University (KFU) at Ahsa (Table 8.23).

| **Name of Uni.** | **No. of whole sample** | **No. of returned copies (%)** | **No. of lost copies (%)** |
|---|---|---|---|
| KSU1 | 7 | 3 (43) | 3 (67) |
| KSU2 | 6 | 6 (100) | 0 (0) |
| OQU1 | 5 | 2 (40) | 3 (60) |
| OQU2 | 1 | 0 (0) | 1 (100) |
| KAU | 4 | 3 (75) | 1 (25) |
| KFU | 2 | 2 (100) | 0 (0) |
| Total | 25 | 16 (64) | 9 (36) |

Table 8.23 Description of science teacher trainers sample by Universities

Table 8.23 show that 16 (64%) science trainers completed and returned the questionnaire[1]. This represented a smaller returned average than that of STs and STAs. This may be attributable to the way in which both types were distributed and collected: STQ was sent and collected personally or through school mail and official post, the STTQ was sent and received through Saudi Mail.

Table 8.24 summarizes personal characteristics data supplied by 16 science trainers. Almost all the sample had a PhD, and three-quarters had more than 5 years teaching experience.

The Table shows that about one-third had not read any article or papers about use of database or spreadsheet in science teaching and did not know about uses of wordprocessors in teaching.

Less than one-third of STTs had no PC, close to the STs results shown in Table 8.7. Not surprisingly STTs had more computer experience than STs, about one-third of STTs had computer experience, whilst, only one-fifth of STs had. However, the proportion of respondents having attended computer courses was found for both STs and STTs to be about one-quarter in each case.

Table 8.24 also indicates that one-quarter of STT sample had written article (s) related to computers, although the article titles[2] show that these were either theoretical articles like "computer literacy" or unrelated to use of computers in teaching.

---

1. See the STTQ in Appendix E.

2. See question 9 in the final section of STTQ at appendix E

| Variable Score | Qua.# | Exp. | DB | SS | WP | PC | CEx. | CC | CArt. |
|---|---|---|---|---|---|---|---|---|---|
| 0* | 1 | 4 | 10 | 14 | 11 | 10 | 11 | 12 | 12 |
| 1 | 15 | 12 | 6 | 2 | 5 | 4 | 5 | 4 | 4 |

# Qua.= qualification, Exp.= experience, DB= database, SS= spreadsheet, WP= wordprocessore, PC= personal computer, CEx.= computer experience, CC= computer courses and CArt.= computer article

* 0= No PhD qualification, 5 years of experience or less and No for all other variables

1= PhD qualification, more than 5 years of experience and Yes for other variables

Table 8.24 Science trainers personal characteristics by group

Because STTs responded to the same knowledge items responded by STs, Table 8.25 presents a summary for STTs and STs responses on the eight items shown previously in Table 8.11. The summary shows that the highest correct response for STT was to item 2, to which more than four-fifths of the sample gave the correct response. The lowest correct response was to item 4, answered correctly by only one-third of the sample.

Like STs, STTs show their highest correct response score with item 2. In half of the items (1, 2, 4 and 5) STs show higher correct response scores than STTs, whilst, STTs show higher in the other items.

| Item No. | Group | F(%) | DN(%) | T(%) |
|---|---|---|---|---|
| 1* | STT | 7 (43.8) | 1 (6.2) | **8 (50)** |
| | ST | 113(42.50 | 43(16.2) | **108(40.6)** |
| 2 | STT | 1 (6.2) | 2 (12.5) | **13 (81.3)** |
| | ST | 43(16.2) | 16(6) | **206(77.4)** |
| 3 | STT | **11 (73.3)** | 2 (13.3) | 2 (13.3) |
| | ST | **116(43.6)** | 50(18.8) | 99(37.2) |
| 4 | STT | **5 (33.3)** | 1 (6.7) | 9 (60) |
| | ST | **73(27.4)** | 11(4.1) | 182(68.4) |
| 5 | STT | **6 (40)** | 7 (46.7) | 2 (13.3) |
| | ST | **82(30.8)** | 86(32.3) | 93(35.0) |
| 6 | STT | **7 (46.7)** | 1 (6.7) | 7 (46.7) |
| | ST | **60(22.6)** | 87(32.7) | 112(42.1) |
| 7 | STT | **6 (37.5)** | 5 (33.3) | 5 (33.3) |
| | ST | **67(25.2)** | 88(33.1) | 108(40.6) |
| 8 | STT | 5 (33.3) | 3 (20) | **7 (46.7)** |
| | ST | 96(36.1) | 86(32.3) | **83(31.2)** |

* Items shown in Table 8.11

Table 8.25 Descriptive statistics for knowledge of computer by group for science teacher trainers (STT) and science teachers (ST)

Not surprisingly STTs show higher correct responses than STs to all items. This may be because their high qualifications, kind of experience and the valuable facilities provided for trainers at Universities. Moreover, STTs are usually involved with computers in many ways, such as educational technology in science teaching, science teaching innovations, using computers in data analysis in their research, etc., whilst there is little computer use among science teachers.

The STTs questionnaire includes four attitude scales: attitudes toward: value of computers for science teaching (VALUE) which includes 7 items, identical to items in the VALUE scale of STQ (there is one extra item in STQ scale); training of science teachers to use computers in their teaching (S.TRAINING) which includes 5 items; their own training to use computers in their teaching (TRAINING) which includes 6 items and the effectiveness or otherwise of use of computers by science pupils (EFFECTIVE), which was exactly the same as the equivalent scale in the ST questionnaire.

Table 8.26 shows that all scale means were greater than the scale mid-point, as for the STs sample. This is not surprising because almost all item means were greater than item mid-point (2.5), the possible item mean. The only two items below the mid-point were items 9 and 24. However, the data suggest that positive attitudes of science trainers are perhaps higher than among science teachers, although the scale means for both cases are very close.

| STTQ No. | STQ No. | | STT | ST |
|---|---|---|---|---|
| 4 | 4 | M | 2.44 | 3.07 |
| | | SD | 0.727 | 0.768 |
| 5 | 5 | M* | 3.13 | 3.34 |
| | | SD | 0.602 | 0.690 |
| 8 | 10 | M | 3.16 | 2.85 |
| | | SD | 0.569 | 0.800 |
| 13 | 16 | M | 2.72 | 2.57 |
| | | SD | 0.547 | 0.791 |

| Item No. | | STT |
|---|---|---|
| 2 | M | 3.50 |
| | SD | 0.516 |
| 9 | M | 1.56 |
| | SD | 0.629 |
| 14 | M | 1.69 |
| | SD | 0.602 |
| 18 | M | 3.31 |
| | SD | 0.479 |

| | | | | |
|---|---|---|---|---|
| 17 | 20 | M | 2.22 | 1.93 |
| | | SD | 0.836 | 0.745 |
| 20 | 25 | M | 2.91 | 2.74 |
| | | SD | 0.584 | 0.771 |
| 23 | 29 | M | 3.25 | 2.98 |
| | | SD | 0.683 | 0.743 |

**VALUE** Scale

Score mean: STT= 20.02; ST= 22.08

Score SD : STT= 4.337; ST= 6.09

| | | | | |
|---|---|---|---|---|
| 1 | 1 | M | 2.69 | 2.75 |
| | | SD | 0.793 | 0.804 |
| 7 | 8 | M | 3.063 | 3.07 |
| | | SD | 0.929 | 0.629 |
| 10 | 12 | M | 2.5 | 2.90 |
| | | SD | 0.730 | 0.786 |
| 12 | 15 | M | 2.72 | 2.82 |
| | | SD | 0.865 | 0.709 |
| 16 | 19 | M | 2.88 | 2.84 |
| | | SD | 0.500 | 0.707 |
| 24 | 30 | M | 3.0 | 3.13 |
| | | SD | 0.632 | 0.708 |

**EFFECTIVE** Scale

Score mean: STT= 16.86; ST= 17.52

Score SD : STT= 4.449; ST= 4.34

*Note M= Mean, SD= Standard Deviation

| | | |
|---|---|---|
| 21 | M | 3.28 |
| | SD | 0.515 |

**S.TRAINING** scale

Score mean= 13.35

Score SD = 2.741

| | | |
|---|---|---|
| 3 | M | 3.06 |
| | SD | 0.854 |
| 6 | M | 2.69 |
| | SD | 0.873 |
| 11 | M | 3.06 |
| | SD | 0.680 |
| 15 | M | 3.19 |
| | SD | 0.544 |
| 19 | M | 2.81 |
| | SD | 0.911 |
| 22 | M | 3.13 |
| | SD | 1.03 |

**TRAINING** Scale

Score mean: STT= 17.94

Score SD : STT= 4.892

Table 8.26 Descriptive statistics of Means and Standard Deviation for the items of the science trainers questionnaire (STTQ) scales. Science teachers' (STQ) data also presented in the similar scales.

The reliability estimations for STQ shown previously in Table 8.19 indicate an alpha of 0.673 for the scale VALUE without item 27 which was not used in the STTQ, acceptable for a scale of seven items. Again, the EFFECTIVE scale has exactly the same items of STQ, so the same reliability can be used for STT questionnaire.

The TRAINING and S.TRAINING scales differ from the STQ scales, so new reliability was sought for both scales.

The alpha reliability for the TRAINING scale was 0.34 and -0.302 for S.TRAINING scale. The complementary alpha shows that the TRAINING scale value could be improved by removing item 6 from the scale, which would make the reliability value run up to 0.612. For this reason, the item was removed from the scale. In contrast, no improvement can be achieved by removing any item from the S.TRAINING scale.

## 8.7 An Official Interview:

During the Riyadh field work period, a semi-structured interview was carried out with the Vice Assisted Minister for Educational Development. The 45-minute official interview gained useful information related to the study which will be incorporated in Chapter 12. The full interview can be read in Appendix G.

## 8.8 Summary:

This chapter has explained the initial analysis of responses given by samples of 266 science teachers and 15 advisors. Three reliable scales have been derived for the STQ. The items of the TRAINING scale have been shown not to be homogeneous and will analysed individually in the next chapter.

Factor analysis has been used to confirm the scale results. Two factors could be treated as scales. Confirming the above result, the unreliable items were these of the TRAINING scale.

Data supplied by 16 science trainers have also been analysed. Three reliable scales and 5 items have been found not to be belong to any scales. These items will analysed individually in the following chapter.

# CHAPTER 9 : :

# DATA ANALYSIS: WITHIN GROUP RELATIONSHIPS

The data from the science teachers' questionnaire, supplied by 266 science teachers (ST), 15 science advisors (STA) and 16 science teacher trainers (STT), who returned completed questionnaires, are presented in this chapter. The results are subjected to data analysis including identification of groups, further analysis of attitude scales, and relationships between variables.

The chapter is divided into two parts. The first part deals with the data collected by STQ from science teachers and advisors, while the second part presents the data collected by STTQ from science teachers' trainers.

## PART: A

The three main relationships presented in the this sections are the relationships between STs' and STAs' attitude scales and items and their characteristics, activities (STs only) and computer knowledge.

To examine whether the different groups had different attitudes, t-tests were carried out to analyse relationships between science teachers' variables and attitudes, whilst the nonparametric median test was carried out on science advisors' relationships, because the number of STAs was too small for parametric analysis.

## 9.1 Relationship Between Sample Characteristics and Attitude Scales and Items:

This section describes some relationships between sample characteristics of the opinion scales VALUE, BENEFIT, EFFECTIVE and the TRAINING items. Tables 9.1 to 9.4 give a summary of science teachers' and science teacher advisors' characteristic variables including qualifications, years of experience, ownership of PC, computer experience, computer courses and courses in uses of computers in teaching, in relation to their attitudes in the scales and items.

Table 9.1 indicates that some STs' characteristics are related to their attitudes to the scale VALUE. These were: 'ownership of PC' (at $p< 0.01$), and 'years of experience' (at $p< 0.05$). Small probability is shown for ownership of PC, indicating the indubitable influence of having a PC on science teachers' attitudes toward the scale VALUE. In contrast, the t-value indicates no significant attitude differences according to variations in 'qualifications', but 'attendance on a computer course' and 'courses in use of computer in teaching' could be significant if the probability is at $p< 0.1$. In addition, F is always significant, which means the variances of the two STs groups are equal in all of the characteristic variables.

The median test most closely resembles the t-test (Siegel and Castellan, 1988). Therefore it was used to analyse STAs data. The median tests of STAs responses show no significant relationship between characteristics and the scale VALUE, though 'PC ownership' is still the most effective variable among STAs personal characteristics.

| Character | Variable | ST N | Mean | SD | F Sig. | t-value | Sig. | STA N | Median | Prob. |
|---|---|---|---|---|---|---|---|---|---|---|
| **Qua.*** | Post-G. | 9 | 23.17 | 3.52 | Sig. | 0.96 | 0.340 | 3 | 22.00 | 1.000 |
| | Grad. | 257 | 22.03 | 3.51 | | | | 11 | | |
| **Exp.** | 0-5 | 95 | 21.44 | 3.66 | Sig. | 2.17 | **0.031** | 0 | - | - |
| | 6+ | 166 | 22.42 | 3.41 | | | | 14 | | |
| **PC** | Yes | 86 | 23.52 | 3.15 | Sig. | 4.83 | **0.000** | 6 | 22.00 | 0.192 |
| | No | 178 | 21.37 | 3.49 | | | | 8 | | |
| **CExp.** | Yes | 58 | 22.66 | 3.42 | Sig. | 1.48 | 0.141 | 2 | 22.00 | 1.000 |
| | No | 204 | 21.90 | 3.51 | | | | 11 | | |
| **CC** | Yes | 62 | 22.78 | 3.17 | Sig. | 1.95 | 0.053 | 5 | 22.00 | 0.580 |
| | No | 200 | 21.79 | 3.59 | | | | 9 | | |
| **CCT** | Yes | 12 | 23.92 | 3.75 | Sig. | 1.92 | 0.056 | 3 | 22.00 | 0.539 |
| | No | 244 | 21.91 | 3.52 | | | | 11 | | |

* Qua.= qualification, Exp.= years of experience, PC= ownership of personal computer, CExp.= computer experience, CC= attended computer courses and CCT= attended courses in use of computers in teaching.

Table 9.1 Relationship between sample-characteristics and the attitude scale **VALUE**

On the scale BENEFIT, STs' 'ownership of PC' had once more the highest t-value and smallest probability and is therefore the characteristic most significant on that scale (Table 9.2). 'years of experience' and 'attending courses in use of computers in teaching' also had significant values. In contrast, the largest probability appeared for qualification variables, confirming the previous indication that this variable has little bearing on the BENEFIT dimension of STs attitudes (Table 9.2).

The results of STAs' data shown in Table 9.2 indicate again no true difference between the two STA groups' characteristics and the scale BENEFIT. Uniform medians were obtained in all characteristics.

| Character | | | | ST | | | | | STA | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Variable** | **N** | **Mean** | **SD** | **F sig.** | **t-value** | **Sig.** | **N** | **Median** | **Prob.** |
| **Qua.** | Post-G. | 9 | 22.11 | 3.72 | Sig. | 0.42 | 0.674 | 3 | 20.00 | 1.00 |
| | Grad. | 257 | 21.64 | 3.29 | | | | 11 | | |
| **Exp.** | 0-5 | 95 | 21.44 | 3.66 | Sig. | 2.17 | **0.031** | 0 | - | - |
| | 6+ | 166 | 22.42 | 3.41 | | | | 14 | | |
| **PC** | Yes | 86 | 22.38 | 3.22 | Sig. | 2.46 | **0.015** | 6 | 20.00 | 1.00 |
| | No | 178 | 21.34 | 3.24 | | | | 8 | | |
| **CExp.** | Yes | 58 | 21.89 | 3.30 | Sig. | 0.64 | 0.524 | 2 | 20.00 | 0.192 |
| | No | 204 | 21.57 | 3.31 | | | | 11 | | |
| **CC** | Yes | 62 | 21.85 | 2.96 | Sig. | 0.55 | 0.585 | 5 | 20.00 | 0.580 |
| | No | 200 | 21.59 | 3.39 | | | | 9 | | |
| **CCT** | Yes | 12 | 23.71 | 3.95 | Sig. | 2.22 | **0.027** | 3 | 20.00 | 0.539 |
| | No | 244 | 21.55 | 3.26 | | | | 11 | | |

* Qua.= qualification, Exp.= years of experience, PC= ownership of personal computer, CExp.= computer experience, CC= attended computer courses and CCT= attended courses in use of computers in teaching.

Table 9.2 Relationship between sample-characteristics and the attitude scale **BENEFIT**

In line with the previous STs' results, Table 9.3 shows that the characteristic 'ownership of PC' had the highest t-value of all the characteristic relationships t=4.83 with the scale EFFECTIVE; the significant of p=0.00 indicates the definite relationship between having a PC and the attitudes toward the scale EFFECTIVE. The characteristic 'years of experience' failed to show a significant relationship with this scale, while the characteristic 'qualification' once again had a small t-value. The other character variables show no true relationships to the scale.

The STAs' median tests show no real significant effect in all of their characteristics.

| Character | Variable | ST N | Mean | SD | F sig. | t-value | Sig. | STA N | Median | Prob. |
|---|---|---|---|---|---|---|---|---|---|---|
| Qua. | Post-G. | 9 | 17.33 | 2.65 | Sig. | -0.20 | 0.844 | 3 | 16.75 | 1.00 |
| | Grad. | 257 | 17.51 | 2.62 | | | | 11 | | |
| Exp. | 0-5 | 95 | 17.50 | 2.81 | Sig. | -0.08 | 0.936 | 0 | - | - |
| | 6+ | 166 | 17.47 | 2.52 | | | | 14 | | |
| PC | Yes | 86 | 23.52 | 3.15 | Sig. | 4.83 | 0.000 | 6 | 16.75 | 0.592 |
| | No | 178 | 21.37 | 3.45 | | | | 8 | | |
| CExp. | Yes | 58 | 17.59 | 2.96 | Sig. | 0.26 | 0.798 | 2 | 16.50 | 0.192 |
| | No | 204 | 17.50 | 2.52 | | | | 11 | | |
| CC | Yes | 62 | 17.52 | 2.45 | Sig. | 0.18 | 0.857 | 5 | 16.75 | 0.266 |
| | No | 200 | 17.45 | 2.66 | | | | 9 | | |
| CCT | Yes | 12 | 18.63 | 3.19 | Sig. | 1.57 | 0.117 | 3 | 16.75 | 1.000 |
| | No | 244 | 17.40 | 2.60 | | | | 11 | | |

* Qua.= qualification, Exp.= years of experience, PC= ownership of personal computer, CExp.= computer experience, CC= attended computer courses and CCT= attended courses in use of computers in teaching

# Negative sign indicates greater mean for the second group.

Table 9.3 Relationship between sample-characteristics and the attitude scale **EFFECTIVE**

Because the scale TRAINING (items: 3, 7, 11, 14, 18, 21, 24 and 26) was found to be unreliable (see section 8.4), t-test and median test were carried out for each item individually.

It was surprising that none of the 8 items had a significant relationship with the variable, 'ownership of PC' at $p < 0.01$ or $p < 0.05$. On the other hand, two items had a significant relationship with PC ownership at $p < 0.1$. These were item 3, "*A computer training programme should be compulsory for every science teacher*", and item 11, "*Science teachers must know a great deal about how computers work if they want to use them* *in science* teaching". However, the least significant item was item 18, "*A computer studies teacher needs to know how to use computers in science teaching before he trains science teachers*".

The other characteristics of STs showed no significant relationship with any of the items, at the $p < 0.1$ level.

The STAs characteristics also showed no significant relationship with the 8 TRAINING items, at $p < 0.1$.

The lack of distinction between groups found according to personal characteristics on scores of the 8 items of TRAINING for both STs and STAs could be associated with the nature of these items.

It can be concluded from the previous tables that the 'ownership of PC' is the variable with strongest effect on the STs scales, and that 'years of experience' also had a significant effect on two scales. In addition, 'attending courses in use of computers in teaching' had significant effect on one scale. No significant effect resulted from any other characteristic. It was likely that 'qualification' had the least effect on the attitudes of the ST sample.

All science advisors' characteristics showed no significant relationship to the attitude scales and items.

The failure to detect differences between the STAs groups may be associated with the median test limitation as a measure of central tendency. It is only appropriate for describing continuous variables. For example, the data 1, 2, 3, 4, 5, 6, 7 and the data 1, 2, 3, 4, 200, 3126, 5421 have the same median of 4. Thus, the median is not particularly sensitive to the exact value of each data value in the distribution, and changing one of the data values of the distribution may or may not have any effect on the value of the median. With a large sample it is more likely that the data are continuous, but this is not the case with small a sample, and that is maybe what was happened to the STAs' data which was supplied by only 15 subjects, i.e a small sample population.

## 9.2 Relationship Between Sample Computer Knowledge and Attitude Scales and Items:

Eight knowledge items were included in the science teachers' questionnaire: computer as a private teacher; computer to introduce information; computer applications in science teaching; need to be a programmer; change within computer typing; PC is different from school computers; computer software in SA market; and the use of commercial software in science teaching.

T-tests and the median tests were carried out on the Means of STs and STAs groups respectively. Their data were divided into two groups according to the correctness of item responses. If the item was in fact true, the responses were scored as Correct for true responses and Wrong for false and do not know responses, but if the item was in fact false, then true and do not know responses scored as Wrong and false responses scored as Correct. The reversal for false items does not affect the significance of the t-test and median results.

Table 9.4 shows a significant relationship between STs' knowledge of computers and the scale VALUE. The items 2, 3, 4 and 5 had very high t-values, indicating a strong relationship with knowledge effecting teachers' attitudes to the VALUE scale. The only two unrelated items were item 6, "*The use of PC is unrelated to the needs of the schools*" and item 7, "*The Saudi Arabian market has various examples of English software, but almost nothing in the Arabic language*". For almost all items, the number in the Wrong group was greater than the number in the Correct group. Therefore, further indication of the poor computer background of SA science teachers is obtained here.

For the STAs, the number in the Wrong group was greater than that in the Correct group in only five items, and was less in three items; this result was expected because of the STAs' extra experience and qualifications. However, the median test did not show significant difference in the attitude scores between the groups for any of the items.

| | | ST | | | | | | | | STA | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| No. | Item description | Group | N | Mean | SD | F Sig. | T-value | Sig. | N | Median | P |
| 1 | Computer as private teacher (T)* | Wrong | 158 | 21.64 | 3.47 | Sig. | 2.40 | **0.017** | 9 | 22.00 | 1.00 |
| | | Correct | 108 | 22.69 | 3.50 | | | | 6 | | |
| 2 | Computer to introduce information (T) | Wrong | 60 | 20.28 | 3.93 | sig. | 4.64 | **0.000** | 5 | 22.00 | 0.282 |
| | | Correct | 206 | 22.59 | 3.21 | | | | 10 | | |
| 3 | Computer applications in science (F) | Wrong | 150 | 21.21 | 3.76 | Sig. | 4.67 | **0.000** | 6 | 22.00 | 0.608 |
| | | Correct | 116 | 23.17 | 3.82 | | | | 9 | | |
| 4 | Need to be a programmer (F) | Wrong | 193 | 21.65 | 3.62 | Sig. | 3.19 | **0.002** | 11 | 22.00 | 0.569 |
| | | Correct | 73 | 23.16 | 2.96 | | | | 4 | | |
| 5 | Change within computer typing (F) | Wrong | 184 | 21.56 | 3.46 | Sig. | 3.58 | **0.000** | 11 | 22.00 | 1.00 |
| | | Correct | 82 | 23.20 | 3.38 | | | | 4 | | |
| 6 | PC is different from school computers (F) | Wrong | 206 | 21.92 | 3.50 | Sig. | 1.26 | 0.210 | 10 | 22.00 | 1.00 |
| | | Correct | 60 | 22.57 | 3.53 | | | | 5 | | |
| 7 | Computer software in SA market (F) | Wrong | 199 | 21.97 | 3.46 | Sig. | 0.79 | 0.432 | 7 | 22.00 | 1.00 |
| | | Correct | 67 | 22.36 | 3.66 | | | | 8 | | |
| 8 | Commercial software in science teaching (T) | Wrong | 183 | 21.77 | 3.51 | Sig. | 2.05 | **0.042** | 10 | 22.00 | 0.608 |
| | | Correct | 83 | 22.72 | 3.46 | | | | 5 | | |

* T= true item, F= false item.

Table 9.4 Relationship between sample-computer knowledge and the attitude scale VALUE

Half of the STs' knowledge variables showed significant relationship with the scale BENEFIT. Table 9.5 shows that items 6 and 7 appeared again as unrelated knowledge variables, while the results obtained from items 2, 3, 4 and 5 confirm the previous indication of their strong relationship with science teachers' attitudes. Moreover, the STAs' knowledge variables continue to show insignificant relationships with their attitude scores.

| | | | ST | | | | | | | STA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No. | Item description | Group | N | Mean | SD | F Sig. | T-value | Sig. | N | Median | P |
| 1 | Computer as private teacher (T) | Wrong | 158 | 21.53 | 3.15 | Sig. | 0.78 | 0.434 | 9 | 20.00 | 1.00 |
| | | Correct | 108 | 21.85 | 3.50 | | | | 6 | | |
| 2 | Computer to introduce information (T) | Wrong | 60 | 20.52 | 3.25 | Sig. | 3.10 | **0.002** | 5 | 20.00 | 0.282 |
| | | Correct | 206 | 21.99 | 3.23 | | | | 10 | | |
| 3 | Computer applications in science (F) | Wrong | 150 | 21.07 | 3.28 | Sig. | 3.39 | **0.001** | 6 | 20.00 | 0.608 |
| | | Correct | 116 | 22.42 | 3.16 | | | | 9 | | |
| 4 | Need to be a programmer (F) | Wrong | 193 | 21.36 | 3.34 | Sig. | 2.39 | **0.018** | 11 | 20.00 | 0.569 |
| | | Correct | 73 | 22.43 | 3.04 | | | | 4 | | |
| 5 | Change within computer typing (F) | Wrong | 184 | 21.15 | 3.25 | Sig. | 3.88 | **0.000** | 11 | 20.00 | 0.282 |
| | | Correct | 82 | 22.80 | 3.10 | | | | 4 | | |
| 6 | PC is different from school computers (F) | Wrong | 206 | 21.60 | 3.29 | Sig. | 0.54 | 0.59 | 10 | 20.00 | 0.608 |
| | | Correct | 60 | 21.86 | 3.30 | | | | 5 | | |
| 7 | Computer software in SA market (F) | Wrong | 199 | 21.49 | 3.27 | Sig. | 1.42 | 0.156 | 7 | 20.00 | 1.00 |
| | | Correct | 67 | 22.15 | 3.33 | | | | 8 | | |
| 8 | Commercial software in science teaching (T) | Wrong | 183 | 21.45 | 3.25 | Sig. | 1.51 | 0.131 | 10 | 20.00 | 0.119 |
| | | Correct | 83 | 22.11 | 3.25 | | | | 5 | | |

Table 9.5 Relationship between sample-computer knowledge and the attitude scale **BENEFIT**

In contrast with the findings on the previous two scales, Table 9.6 shows that half of the STs' knowledge items were significantly related to the scale EFFECTIVE. Items 2 and 3 again showed the highest t-value among the items, whilst items 6 and 7 again showed the lowest t-value.

No significant relationship was found between any of the STAs items and the scale EFFECTIVE.

| | | | ST | | | | | | STA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **No.** | **Item description** | **Group** | **N** | **Mean** | **SD** | **F Sig.** | **T-value** | **Sig.** | **N** | **Median** | **P** |
| 1 | Computer as private | Wrong | 158 | 17.22 | 2.59 | Sig. | 2.11 | **0.036** | 9 | 17.00 | 0.622 |
| | teacher (T) | Correct | 108 | 17.91 | 2.60 | | | | 6 | | |
| 2 | Computer to intro- | Wrong | 60 | 16.10 | 2.52 | Sig. | 4.93 | **0.000** | 5 | 17.00 | 0.580 |
| | duce information (T) | Correct | 206 | 17.91 | 2.50 | | | | 10 | | |
| 3 | Computer applica- | Wrong | 150 | 16.91 | 2.64 | Sig. | 4.32 | **0.000** | 6 | 17.00 | 1.00 |
| | tions in science (F) | Correct | 116 | 18.26 | 2.38 | | | | 9 | | |
| 4 | Need to be a pro- | Wrong | 193 | 17.36 | 2.60 | Sig. | 1.47 | 0.143 | 9 | 17.00 | 0.604 |
| | grammer (F) | Correct | 73 | 17.89 | 2.62 | | | | 4 | | |
| 5 | Change within com- | Wrong | 184 | 17.25 | 2.57 | Sig. | 2.38 | **0.018** | 11 | 17.00 | 1.00 |
| | puter typing (F) | Correct | 82 | 18.07 | 2.63 | | | | 4 | | |
| 6 | PC is different from | Wrong | 206 | 17.43 | 2.65 | Sig. | 0.18 | 0.420 | 10 | 17.00 | 1.00 |
| | computers in schools (F) | Correct | 60 | 17.74 | 2.48 | | | | 5 | | |
| 7 | Computer software | Wrong | 199 | 17.39 | 2.47 | Sig. | 1.18 | 0.237 | 7 | 17.00 | 1.00 |
| | in SA market (F) | Correct | 67 | 17.83 | 2.99 | | | | 8 | | |
| 8 | Commercial software | Wrong | 183 | 17.33 | 2.58 | Sig. | 1.57 | 0.118 | 10 | 17.00 | 0.329 |
| | in science teaching (T) | Correct | 83 | 17.87 | 2.66 | | | | 5 | | |

Table 9.6 Relationship between sample-computer knowledge and the attitude scale EFFECTIVE

As explained earlier, each of the TRAINING items needed an individual analysis with the personal variables, including knowledge items. Because not all of the TRAINING items were significant, only significant items are presented in Table 9.7.

T-test on STs data indicated that the TRAINING item 11, "*Science teachers must know a great deal about how computers work if they want to use them in science teaching*", was significantly related to half of the computer knowledge items. These were items 1, 4, 6 and 8.

TRAINING items 3, 18 and 21 showed significant relationship with two of the knowledge items. Items 3 and 21 both showed a strong relationship, p=0.005 and 0.004, respectively, with knowledge item 2, "*Computers are used to introduce a large amount of information to pupils*".

The computer knowledge item 7 showed no real relationship with any of the TRAINING items, this item was, "*The Saudi Arabian market has various examples of English software, but almost nothing in the Arabic language*".

Table 9.7 also shows that F value is frequently significant except between TRAINING item 11 and knowledge item 1, where F was not significant. The reason for that is because the group variances were not equal, therefore in this case the separate-variance t-test should be used (Norusis, 1990). However the t-value was not very different from the pooled variance estimate.

| | | ST | | | | STA | | |
|---|---|---|---|---|---|---|---|---|
| **No.** | **Item description** | **Sig. items** | **F Sig.** | **T-value** | **Sig.** | **Sig items** | **median** | **P** |
| 1 | Computer as private teacher (T) | 11 | NS* | 2.12 | 0.035 | None | | |
| | | 21 | Sig | 2.48 | 0.014 | | | |
| 2 | Computer to introduce information (T) | 3 | Sig. | 2.84 | 0.005 | 21 | 3 | 0.044 |
| | | 21 | Sig. | 2.88 | 0.004 | | | |
| 3 | Computer applications in science (F) | 3 | Sig. | 2.07 | 0.040 | None | | |
| | | 18 | Sig. | 2.06 | 0.040 | | | |
| 4 | Need to be a programmer (F) | 11 | Sig. | 3.35 | 0.001 | None | | |
| | | 21 | Sig. | 2.46 | 0.014 | | | |
| 5 | Change within computer typing (F) | 3 | Sig. | 2.02 | 0.045 | None | | |
| 6 | PC is different from school computers (F) | 11 | Sig. | 2.09 | 0.038 | 11 | 1 | 0.002 |
| | | 18 | Sig. | 2.18 | 0.030 | | | |
| 7 | Computer software in SA market (F) | None | | | | 11 | 1 | 0.007 |
| 8 | Commercial software in science teaching (T) | 11 | Sig. | 3.06 | 0.002 | 11 | 1 | 0.089 |
| | | | | | | 24 | 2 | 0.089 |

* If F not significant, the separate variance estimate was used

Table 9.7 Relationship between significant TRAINING items and computer knowledge items by sample

It is not surprising that half of the knowledge items had no significant relationship with the STAs' TRAINING attitude items, because previous results had show insignificant relationships on all three scales. Only three relationships were significant below the used-level of 0.05.

The previous analysis of the relationship between samples' computer knowledge and their attitudes indicates that, in the STs' case, knowledge items 2, 3, 4, 5 had frequently significant relation with all of the scales and even with some TRAINING items, while items 6 and 7 were often not significant items.

Knowledge item 2 "*Computer to introduce information*" had the highest t-value for both of TRAINING items 3 and 21, while item 11, "*Science teachers must know a great deal about how computers work if they want to use them in science teaching*", was most significantly related with the computer knowledge variables among the items, being significantly related to four computer knowledge items.

## 9.3 Relationship Between Science Teacher Activity and Attitude Scales and Items:

Eight science teacher activities were included in the STQ:

- Allow students to do experiments by themselves (Experiment),
- Use of video in teaching (Video), use of overhead projector in class (Overhead),
- Make personal visits to computer centres (Computer visit),

. Include discussion of TV science programmes in teaching (TV programmes),

. Read educational computing articles (Computer articles),

. Meet with CT to discuss computer uses in teaching (CT meeting),

. Advise students to follow developments in technology (IT news).

The subjects were asked to state how many times they perform each activity: daily (1\D), weekly (1\W), monthly (1\M), termly (1\T) or never (N).

Only science teachers were involved in the activity part (see section 8.1). The sample was divided into two groups, the active group who responded 1\D, 1\W or 1\M, and the non-active group, who responded 1\T or Never.

T-tests were carried out for data supplied by 266 science teachers between the two groups according to their attitudes to the scales, VALUE, BENEFIT, EFFECTIVE, and the TRAINING items.

Table 9.8 shows that the Means of the active group were almost always greater than those of the non-active group, but the difference of the Means and therefore the attitudes between the two groups are not always significant (Table 9.8). However, sign of generally more positive attitudes on the part of the active group toward the scale VALUE are shown here.

From the t-test results shown in Table 9.8 it can be seen that three science teacher activities are significantly related ($p < 0.05$) to the scale VALUE. These are, computer visits, computer articles, and computer teacher meetings. Among them 'computer articles' had the highest t-value, while the lowest t-value among the whole activities was the 'video' activity, which scored only 0.06. However, the activity 'IT news' had a significant t value at the level of 0.1.

| Teacher Activities | Group | N | Mean | SD | F Sig. | T-value | Sig. |
|---|---|---|---|---|---|---|---|
| Experiments | Active | 190 | 22.12 | 3.52 | Sig. | 0.93 | 0.355 |
| | Non-Act. | 73 | 21.68 | 3.35 | | | |
| Video | Active | 144 | 21.97 | 3.71 | Sig. | -0.06# | 0.951 |
| | Non-Act. | 115 | 22.00 | 3.17 | | | |
| Overhead | Active | 122 | 22.17 | 3.36 | Sig. | 0.88 | 0.382 |
| | Non-Act. | 139 | 21.80 | 3.57 | | | |
| Computer visits | Active | 65 | 23.20 | 3.13 | Sig. | 3.06 | **0.002** |
| | Non-Act. | 200 | 21.69 | 3.57 | | | |
| TV Programmes | Active | 169 | 22.20 | 3.57 | Sig. | 0.98 | 0.327 |
| | Non-Act. | 92 | 21.76 | 3.45 | | | |
| Computer articles | Active | 85 | 23.09 | 3.30 | Sig. | 3.31 | **0.001** |
| | Non-Act. | 171 | 21.56 | 3.57 | | | |
| CT Meeting | Active | 105 | 22.56 | 3.31 | Sig. | 2.08 | **0.039** |
| | Non-Act. | 149 | 21.63 | 3.64 | | | |
| IT News | Active | 215 | 22.26 | 3.38 | Sig. | 1.84 | 0.066 |
| | Non-Act. | 47 | 21.22 | 4.03 | | | |

# Negative sign shows non-active group have the higher mean score

Table 9.8 Relationship between Science Teacher-Activity and the attitude scale **VALUE**

Only one activity, 'computer articles', was related to the scale BENEFIT at the level of 0.05, although three more activities were significant at the level of 0.1; these were: 'video', 'computer visits' and 'IT news'. The activity 'CT meeting' had the lowest t-value among all activities (Table 9.9).

Although only one activity group difference was found to have a significant t-value, all of the active group Means are greater than those of the non-active group for all of the activities.

| Teacher Activity | Group | N | Mean | SD | F | T-value | Sig. |
|---|---|---|---|---|---|---|---|
| Experiments | Active | 190 | 21.72 | 3.35 | 1.25 | 1.01 | 0.312 |
| | Non-Act. | 73 | 21.27 | 3.99 | | | |
| Video | Active | 144 | 21.89 | 3.32 | 1.15 | 1.75 | 0.082 |
| | N-Act. | 115 | 21.19 | 3.11 | | | |
| Overhead | Active | 122 | 21.87 | 3.25 | 1.01 | 1.44 | 0.152 |
| | Non-Act. | 139 | 21.30 | 3.24 | | | |
| Computer visits | Active | 65 | 22.22 | 3.39 | 1.10 | 1.67 | 0.097 |
| | Non-Act. | 200 | 21.45 | 3.23 | | | |
| TV Programmes | Active | 169 | 21.89 | 3.29 | 1.03 | 1.49 | 0.138 |
| | Non-Act. | 92 | 21.27 | 3.23 | | | |
| Computer articles | Active | 85 | 22.34 | 3.24 | 1.02 | 2.31 | **0.021** |
| | Non-Act. | 171 | 21.35 | 3.22 | | | |
| CT Meeting | Active | 105 | 21.75 | 3.19 | 1.12 | 0.57 | 0.572 |
| | Non-Act. | 149 | 21.51 | 3.38 | | | |
| IT News | Active | 215 | 21.84 | 3.29 | 1.04 | 1.85 | 0.066 |
| | Non-Act. | 47 | 20.86 | 3.23 | | | |

Table 9.9 Relationship between Science Teacher-Activity and the attitude scale **BENEFIT**

Table 9.10 indicates that three science teacher activities had significant relationships with the scale EFFECTIVE. 'computer articles', 'CT meeting' and 'IT news' showed t-test significance at p< 0.05 or better, while 'TV programme' was significant at the level of 0.1. However, 'IT nnews' seems to have the strongest relationship to the scales, whilst 'experiments' has the lowest t-value among all activities.

The Table 9.10 also shows that the active group Means are greater than those of the non-active Means for all of the significant activities, that is to say, the active group had more positive attitudes to the scale EFFECTIVE with these three activities.

| Teacher Activity | Group | N | Mean | SD | F | T-value | Sig. |
|---|---|---|---|---|---|---|---|
| Experiments | **Active** | 190 | 17.44 | 2.65 | 1.16 | -0.25 | 0.803 |
| | **Non-Act.** | 73 | 17.53 | 2.47 | | | |
| Video | **Active** | 144 | 17.34 | 2.71 | 1.35 | -0.92 | 0.356 |
| | **Non-Act.** | 115 | 17.63 | 2.33 | | | |
| Overhead | **Active** | 122 | 17.55 | 2.67 | 1.11 | 0.57 | 0.570 |
| | **Non-Act.** | 139 | 17.37 | 2.37 | | | |
| Computer visits | **Active** | 65 | 17.94 | 2.16 | 1.59 | 1.61 | 0.108 |
| | **Non-Act.** | 200 | 17.34 | 2.72 | | | |
| TV Programmes | **Active** | 169 | 17.70 | 2.54 | 1.12 | 1.82 | 0.070 |
| | **Non-Act.** | 92 | 17.09 | 2.69 | | | |
| Computer articles | **Active** | 85 | 18.05 | 2.41 | 1.25 | 2.48 | **0.014** |
| | **Non-Act.** | 171 | 17.20 | 2.70 | | | |
| CT Meeting | **Active** | 105 | 17.97 | 2.44 | 1.22 | 2.48 | **0.014** |
| | **Non-Act.** | 149 | 17.15 | 2.70 | | | |
| IT News | **Active** | 215 | 17.71 | 2.54 | 1.24 | 2.77 | **0.006** |
| | **Non-Act.** | 47 | 16.56 | 2.83 | | | |

Table 9.10 Relationship between science teachers' activity and the attitude scale **EFFECTIVE**

Table 9.11 shows that TRAINING item 3, "*A computer training programme should be compulsory for every science teacher*" has a significant relationship with four teachers' activities and the item 26 has significant relations with three activities. However, item 7 is significantly related to only one activity, while items 11, 14, 18, 21 and 24 have no real relationship with any of the science teachers' activities.

The activity, 'computer articles' has the greater number of significantly related items and the activity, 'visits' has two significant related items. That would confirm the previous indication about their effect on science teachers' attitudes. In contrast, the activities, 'experiments' and 'video' have no significant relationship with any of the TRAINING items.

| **Teacher Activity** | **Sig. Items** | **F Sig.** | **T-value** | **Sig.** |
|---|---|---|---|---|
| Experiments | None | - | - | - |
| Video | None | - | - | - |
| Overhead | 26 | Sig. | 2.28 | 0.023 |
| Computer visits | 3 | Sig | 2.06 | 0.041 |
| | 26 | Sig. | 2.05 | 0.041 |
| TV Programmes | 7 | Sig. | 2.15 | 0.032 |
| Computer articles | 3 | Sig. | 1.99 | 0.048 |
| | 24 | Sig. | 1.98 | 0.049 |
| | 26 | Sig. | 2.66 | 0.008 |
| CT Meeting | 3 | Sig. | 2.78 | 0.006 |
| IT News | 3 | Sig. | 2.01 | 0.046 |

Table 9.11 Relationship between science teachers' activity and **TRAINING** attiude items

It can be concluded that the activity 'computer articles' had the strongest relationship with the science teachers' attitudes generally. In this activity, the subjects were asked to tell how many times they read educational computing articles to look for teaching ideas.

The activities, 'CT meeting', 'IT news', and 'visits' also had significant relations, while the other activities seemed to have no significant relationships to science teachers' attitudes.

It is noticeable that all significant activities require use of teachers' leisure times; teachers need to give up their own time for these activities. These activities are not compulsory teaching jobs.

## 9.4 Science Teacher Factors Relations:

Chapter 8 derived two reliable factors: IMPORTANT and PROBLEM, together they accounted for 31.2 % of the total item variance.

Tables 9.12 to 9.14 summarise the significant relationships between the two factors and science teachers' personal characteristics, computer knowledge and activities.

Two characteristics are significantly related to the IMPORTANT factor. These are ownership of PC and attending courses in use of computers in teaching. The characteristics PC and years of experience are also related to the factor PROBLEM. The Table 9.12 shows that PC has the highest t-value in the factor IMPORTANT.

| | | IMPORTANT | | | PROBLEM | |
|---|---|---|---|---|---|---|
| **Character** | **F Sig.** | **T-value** | **Sig.** | **F Sig.** | **T-value** | **Sig.** |
| Qua. | Sig. | 0.46 | 0.644 | - | - | - |
| Exp. | Sig. | - | - | Sig. | 3.52 | **0.001** |
| PC | Sig. | 4.23 | **0.000** | Sig. | 2.54 | **0.012** |
| CoEx | Sig. | - | - | - | - | - |
| CC | Sig. | - | - | - | - | - |
| CoT | Sig. | 2.15 | **0.032** | - | - | - |

Table 9.12 Significant relationship between science teacher-characteristics and the factors **IMPORTANT** and **PROBLEM**

Table 9.13 shows that six knowledge items are related to the factor IMPORTANT, but unlike this factor, the PROBLEM factor showed no significant relationship with any of the computer knowledge items. Among them, 'computer to introduce information' has the highest t-value. The PC variable also indicates a strong relationship to the factor.

| | | IMPORTANT | | | PROBLEM | |
|---|---|---|---|---|---|---|
| **Item description** | **F Sig.** | **T-value** | **Sig.** | **F Sig.** | **T-value** | **Sig.** |
| Computer as private teacher | Sig. | 2.42 | 0.016 | - | - | - |
| Computer to introduce information | Sig. | 5.38 | 0.000 | - | - | - |
| Computer applications in science | Sig. | 4.74 | 0.000 | - | - | - |
| Need to be a programmer | Sig. | 2.54 | 0.012 | - | - | - |
| Change within computer typing | Sig. | - | | - | - | - |
| PC is different from school computers | Sig. | 3.83 | 0.000 | - | - | - |
| Computer software in SA market | Sig. | - | | - | - | - |
| Commercial software in science teaching | Sig. | 2.01 | 0.046 | - | - | - |

Table 9.13 Significant relationship between science teachers' computer knowledge and the factors **IMPORTANT** and **PROBLEM**

Four science teachers' activities were related to the factor IMPORTANT. These were 'computer visits', 'computer articles', 'CT meeting' and 'IT news'. Computer articles had the strongest relationship to the factor of all activities. Computer visits also had a strong relationship. Meanwhile, it seems that four activities had no real relationship to the factor IMPORTANT. These were, Experiments, Video, Overhead and TV programmes (Table 9.14).

The factor PROBLEM again showed weak relationship to the activities. Only 'video' activity was related to the factor.

| | | IMPORTANT | | | PROBLEM | |
|---|---|---|---|---|---|---|
| **Activity** | **F Sig.** | **T-value** | **Sig.** | **F Sig.** | **T-value** | **Sig.** |
| Experiments | Sig. | - | - | - | - | - |
| Video | Sig. | - | - | Sig. | 2.16 | **0.032** |
| Overhead | Sig. | - | - | - | - | - |
| Computer visits | Sig. | 2.90 | **0.004** | - | - | - |
| TV programmes | - | - | - | - | - | - |
| Computer articles | Sig. | 3.41 | **0.001** | - | - | - |
| CT meeting | Sig | 2.57 | **0.011** | - | - | - |
| IT news | Sig. | 2.61 | **0.009** | - | - | - |

Table 9.14 Significant relationship between science teachers' activities and the factors **IMPORTANT** and **PROBLEM**

## 9.5 Summary:

Table 9.15 summarises the science teachers' questionnaire results presented in this chapter. It also allows direct comparison between the three opinion scales and the two factor scales.

The Table 9.15 also shows the similarity between the results of the factor IMPORTANT and the three scales, though the closest similarity was with the scale VALUE. This may be because the 19 items of the factor IMPORTANT and the 4 items of the factor PROBLEM are almost similar to these of the scales VALUE, BENEFIT and EFFECTIVE. Therefore similar results were expected for the factors.

| Attitudes | VALUE | BENEFIT | EFFECTIVE | IMPORTANT | PROBLEM | 3* | 7 | 11 | 14 | 18 | 21 | 24 | 26 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Character | | | | | | | | | | | | | |
| Qua. | | | | | | | | | | | | | |
| Exp | + | + | | | + | | | | | | | | |
| PC | + | + | + | + | + | | | | | | | | |
| CExp. | | | | | | | | | | | | | |
| CC | | | | | | | | | | | | | |
| CoT | | + | | + | | | | | | | | | |
| Knowledge item | | | | | | | | | | | | | |
| 1 | + | | + | + | | | | + | | | + | | |
| 2 | + | + | + | + | | + | | | | | + | | |
| 3 | + | + | + | + | | + | | | | + | | | |
| 4 | + | + | | + | | | | + | | | + | | |
| 5 | + | + | + | | | + | | | | | | | |
| 6 | | | | + | | | | + | | + | | | |
| 7 | | | | | | | | | | | | | |
| 8 | + | | | + | | | | + | | | | | |
| Activity | | | | | | | | | | | | | |
| Experiments | | | | | | | | | | | | | |
| Video | | | | | + | | | | | | | | |
| Overhead | | | | | | | | | | | | | + |
| Computer visit | + | | | + | | + | | | | | | | + |
| TV programmes | | | | | | | + | | | | | | + |
| Computer article | + | + | + | + | | + | | | | | | + | + |
| CT meeting | + | | + | + | | + | | | | | | | |
| IT news | | | + | + | | + | | | | | | | |

+ Indicates positive significant relation (p< 0.05)

* TRAINING items

Table 9.15 Science teachers' results: summary of scales, factors and items

It seems that amongst the science teachers' characteristics ownership of a PC had the greatest number of significant relationships. All of the scales (and factors) show a significant relationship to this characteristic. Years of experience was also significantly related to most of the scales and factors. However, no significant relationship was found between any of science teachers' characteristics and their score on the TRAINING items.

The Table 9.15 indicates that most of the computer knowledge items were significantly related to most of the scales, factors and several TRAINING items. Knowledge items 2, 'computer to introduce information', 3, 'computer applications in science' and 4, 'need to be a programmer', are strongly related to science teachers' attitudes. The only knowledge item which showed no relationship was item 7, 'computer software in the SA market', although all other knowledge variables showed strong link to teachers' attitudes.

In addition, few science teachers' activities show significant relationships with their attitudes generally. Among them, Computer articles and CT meeting had the greatest number of significant relationships.

Examination of the results of science teachers' activities in Table 9.15 shows that the activities most related to the attitudes generally were these which were referred to computers, these were, Computer visit, Computer article and Computer studies teacher meeting.

The TRAINING item 11, "*Science teachers must know a great deal about how computers work if they want to use them in science teaching*" was the item most related to the science teachers' knowledge. It was related to half of the computer knowledge items. The same number of relations was shown for the item 3 "*A computer training programme should be compulsory for every science teacher*", with the science teachers' activities.

# PART : B

## 9.5 Science Trainer Data Analysis:

Chapter Eight identified three reliable scales and six individual items for the STTQ. The scales were VALUE ( 7 items), EFFECTIVE (6 items), and TRAINING ( 5 items).

Relationships between the data supplied by 16 science trainers are presented in the following Tables, including relationships between STTs' personal data and computer knowledge and their attitudes in the scales and items. The Median test was used because of the small size of the sample.

Table 9.16 does not include the characteristics 'qualification', because almost all of the sample had the same qualification (see Table 8.24); therefore this variable was removed from the analysis.

The results shown in Table 9.16 reveal the weak relationship between the STTs' characteristics and their attitudes. It was not surprising that PC had the strongest relationship with the scales and items because previous findings from the STs suggested the same result. However, use of wordprocessor also appears to be related to some of the STTs' attitudes, while almost no true relationships exist between the other characteristics and the attitude scales and items. Nevertheless, the scale TRAINING shows the strongest relationships among all scales and items.

| Attitudes | VALUE | EFFECTIVE | TRAINING | 2 | 6 | 9 | 14 | 18 | 21 |
|---|---|---|---|---|---|---|---|---|---|
| **Character** | | | **Median Prob.** | | | | | | |
| **Exp.*** | 0.077 | 0.569 | **0.019** | 0.569 | 1.000 | 0.569 | 1.000 | 0.547 | 0.547 |
| **DB** | 0.608 | 1.000 | 0.302 | 1.000 | 1.000 | 0.608 | 1.000 | 1.000 | 1.000 |
| **SS** | 0.467 | 1.000 | 0.175 | 0.467 | 1.000 | 0.467 | 1.000 | 0.083 | 1.000 |
| **WP** | 1.000 | 0.282 | **0.005** | 1.000 | 0.509 | 0.282 | 1.000 | **0.000** | **0.013** |
| **PC** | **0.000** | 0.559 | 0.070 | **0.000** | 0.506 | 0.070 | ==^ | **0.005** | 0.095 |
| **CExp.** | 1.000 | 0.282 | **0.005** | 1.000 | 1.000 | 0.026 | 1.000 | 0.245 | 0.245 |
| **CC** | 1.000 | 0.569 | 1.000 | 0.569 | 1.000 | 1.000 | 1.000 | 1.000 | 0.245 |
| **CArt.** | 1.000 | 1.000 | 0.596 | 1.000 | 0.214 | 1.000 | 1.000 | 0.245 | 0.245 |

* Exp.= experience, DB= database, SS= spreadsheet, WP= wordprocessor, PC= personal computer, CEx.= computer experience, CC= computer courses and CArt.= computer articles

^ The values are all less than the Median

Table 9.16 Median test exact probability between STTs' characteristics and attitude scales and items

The computer knowledge items answered by 16 STTs shown in Table 9.17 indicate slight relationships to the STTs attitudes scales and items generally. Nevertheless, item 1 is the only item which shows a significant relationship with the majority of the attitude scales and items. This item is, "*Computer can be used as private tutor*".

Among the scales and items, the scale TRAINING had the smallest probability, p = 0.001, with knowledge item 1, indicating that the scale is strongly related to the two groups of item 1. In addition, the scale EFFECTIVE had also small probability, p = 0.01, with the item.

| Attitudes | VALUE | EFFECTIVE | TRAINING | 2 | 6 | 9 | 14 | 18 | 21 |
|---|---|---|---|---|---|---|---|---|---|
| Item | | | Median Prob. | | | | | | |
| Know1* | 0.619 | **0.010** | **0.001** | 1.000 | 1.000 | **0.010** | 1.000 | **0.026** | **0.026** |
| Know2 | 1.000 | 1.000 | 0.213 | 1.000 | 0.071 | 0.200 | 1.000 | 0.509 | 0.509 |
| Know3 | 1.000 | 1.000 | 0.308 | 1.000 | **0.018** | 0.282 | 1.000 | 0.119 | 0.119 |
| Know4 | 1.000 | **0.026** | 0.106 | 1.000 | 0.509 | 1.000 | 1.000 | 0.245 | **0.013** |
| Know5 | 0.119 | 1.000 | 0.302 | 0.119 | 1.000 | 0.604 | 0.375 | 0.300 | 1.000 |
| Know6 | 1.000 | 0.315 | 0.126 | 0.315 | 1.000 | 0.315 | 1.000 | 0.600 | 0.106 |
| Know7 | 1.000 | 0.119 | 0.302 | 0.608 | 1.000 | **0.007** | 0.375 | 1.000 | 0.300 |
| Know8 | **0.041** | 0.315 | 0.126 | 0.315 | 1.000 | 0.315 | 0.438 | 0.600 | 0.600 |

* Know1 = Computer knowledge item 1

Table 9.17 Median test exact probability between the STTs' computer knowledge and attitude scales and items

In summary, two relationship studies have been carried out for the STTs data: relationship between the STTs' characteristics and their attitudes, and relationship between the STTs' computer knowledge and their attitudes.

It seems that the characteristics 'ownership of PC' and 'know about wordprocessor in teaching' were significantly related to the sample attitudes, while the only computer knowledge item showing significant relationship was item 1. However, the scale TRAINING was the most significant variable among the scales and items in both the characteristics and knowledge relationships of STTs.

# CHAPTER 10 : :

# COMPUTER STUDIES TEACHERS' SAMPLE AND DATA ANALYSIS

The previous two chapters have focused on the science teachers', advisors' and trainers' samples and the findings from the data supplied by each sample. This chapter concerns the sample of computer studies teachers (CST) and the results from data supplied by them.

## 10.1 Selection and Description of the Sample:

The 1992 yearly report of the "Centre of Statistical Data & Educational Documentation" (CSDED) indicates that Saudi Arabian secondary education involves 125 computer studies teachers working at 140 secondary schools[1]. About one-third of those teachers are based in three cities: Riyadh, Jeddah and Madinah.

The CSTs' sample was identified as all computer studies teachers at the schools from which the science teachers' sample was selected. It consisted of 43 computer studies teachers in 40 secondary schools in the three cities of Riyadh, Jeddah and Madinah which have computer equipment.

Copies of the computer studies teachers' questionnaire (CSTQ) which has been described in Chapter Seven were distributed and collected in

[1] Some schools share a computer teacher.

the same way and during the same period as those of the science teachers in each of the three cities (see section 8.1). 38 teachers completed and returned the questionnaire (Table 10.1 and Figure 10.1).

| City | No. of whole sample | No. Of returned copies (%) | No. Of Lost copies (%) |
|---|---|---|---|
| **Riyadh** | 18 | 14 (78%) | 4 (13%) |
| **Jeddah** | 14 | 14 (100%) | 0 (0%) |
| **Madinah** | 11 | 10 (91) | 1 (9) |
| **Total** | 43 | 38 (88) | 5 (12) |

Table 10.1 Graphical locations of the sample of computer studies teachers.

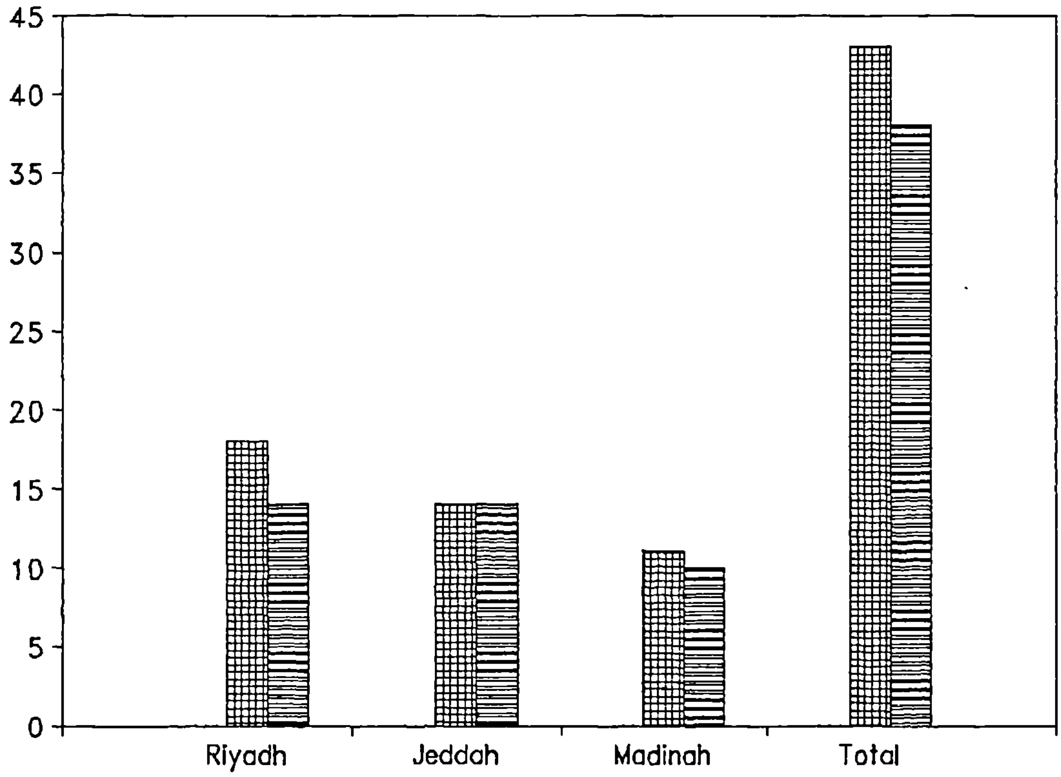



Figure 10.1 Distribution of distributed and returned questionnaires by city.

Tables 10.2 to 10.5 summarise the personal data supplied by the 38 computer studies teachers.

Table 10.2 and Figure 10-2 show that the largest group of computer studies teachers specialized in computer science, that is about two-fifths of the sample, while about 16% of the sample were computer engineering specialists. However, only about one-fifth of the sample indicated that they specialized in computer and education. These had mainly qualified at colleges of education or had an Educational Diploma. (See tables below.)

By referring to the questionnaires, those in the "Others" category were mainly mathematics specialists indicating the involvement of a minority of subject teachers in teaching computer studies.

| | N=36 | % |
|---|---|---|
| Computer science | 15 | 39.5 |
| Computer engineering | 6 | 15.8 |
| Computer and education | 8 | 21.1 |
| Others | 7 | 18.4 |

Table 10.2 Subject specialisms of the sample.

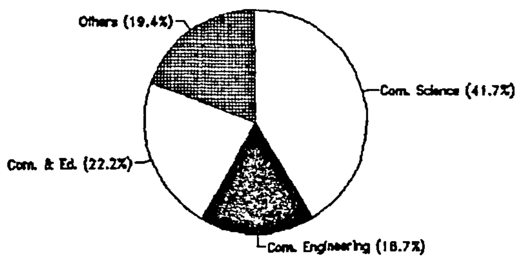



Figure 10.2 Subject distribution of the sample.

In line with the previous result, Table 10.3 and Figure 10-3 show that half of the CSTs had a qualification in science (computer science), and about one-fifth of the sample had a degree in engineering (computer engineering), while less than a quarter of the sample had a first degree in education. Table 10.3 also shows the absence of post-graduate degrees among the whole sample. Only 11% of the sample had in addition to these qualifications, a Diploma in Education.

| | N=38 | % |
|---|---|---|
| MEd | 0 | 0 |
| MSc | 0 | 0 |
| BEd | 9 | 23.7 |
| BSc | 19 | 50 |
| BEg | 7 | 18.4 |
| Others | 3 | 7.9 |
| Ed. Diploma | 4 | 11 |

Table 10.3 Qualifications of the sample.

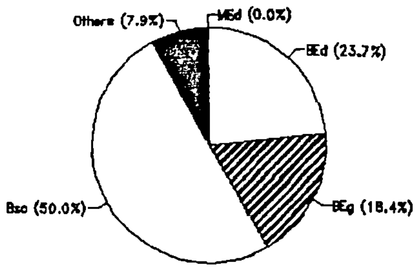



Figure 10.3 Qualification distribution of the sample.

It was not surprising that the majority of CSTs had less than five years of experience. This is probably because computers and computer studies were introduced to the schools only recently. (See Chapter One and Table 10.4.)

| Years of Experience | N=37 | % |
|---|---|---|
| 0-5 | 30 | 81 |
| 6+ | 7 | 19 |

Table 10.4 Years of experience for CSTs in the sample

Table 10.5 summarises the courses and experience responded by the CST sample, including pre-service training and INSET.

The data in Table 10.5 indicate that a large percentage of the sample had received training in databases, wordprocessors and spreadsheets, almost all of them had trained on wordprocessors and databases, while two thirds had trained on spreadsheets. One third of the sample had trained in the use of computer networks, although these do not exist in the schools. It was not surprising to find that the majority of CSTs had a personal computer.

A few teachers, constituting only about one-third of the sample, had attended a course in general teaching methods. A majority had attended courses related specifically to the use of computers in teaching, often the teaching of computer studies.

| **Variable** | DB* | SS | WP | Net. | PC | TC | CCT |
|---|---|---|---|---|---|---|---|
| **Yes (%)** | 32 (91) | 23 (68) | 35 (95) | 11 (31) | 31 (84) | 12 (33) | 31 (86) |
| **NO (%)** | 3 (9) | 11 (32) | 2 (5) | 25 (69) | 6 (16) | 24 (67) | 5 (14) |

*** DB= had training on database, SS= had training on spreadsheet, WP= had training on wordprocessor, Net.= had training on computer networks, PC= have a personal computer, TC= attended courses in teaching methods and CCT = attended courses related to use of computers in teaching.**

Table 10.5 Previous training of the sample

## 10.2 Scoring the Responses:

Responses to the attitude items in the CSTQ were scored as described previously with STs' attitude data (see section 8.2).

## 10.3 Confirming the Scales:

As described in section 7.3 the three scales of the CSTQ were developed from the preliminary study and were used in the pilot study also. The 25 attitude items used for the CSTQ in the main study belonged to the three scales used for the other instruments in both the preliminary and pilot studies. The scales were:

- Attitudes to the value of computers for science teaching (**VALUE**), including seven items.
- Attitudes toward training science teachers to use computers in their teaching (**ST.TRAINING**), comprising about half of the questionnaire (13 items) because of the importance of this scale to the main target of the thesis.
- Attitudes toward training in teaching methods (**TRAINING**), made up of five items.

Tables 10.6 to 10.8 summarise the responses for each scale in the CSTQ using data supplied by the 38 computer studies teachers. The tables give the frequencies, means and the standard deviations for each item and the score mean and score standard deviations for each scale.

Table 10.6 shows that almost all of item means in the scale VALUE were greater than the item mid-point (=2.5), the exception being item 7, "*If computers were introduced into science teaching, then problems would arise as a result*". The highest mean was for item 1. The score-mean of the scale was above its mid-point (20.30 > 17.5). This indicates positive attitudes toward the scale generally.

| No | Items | SA=4* | A=3 | DA=2 | SDA=1 | M | SD |
|---|---|---|---|---|---|---|---|
| 1 | Teaching science with the aid of computers will make science teaching easier. | 19 | 12 | 6 | 0 | 3.33 | 0.756 |
| 4 | The use of computers in science teaching should be made compulsory immediately. | 10 | 10 | 16 | 1 | 2.78 | 0.875 |
| 7 | If computers were introduced into science teaching, then problems would arise as a result (N)#. | 3 | 4 | 23 | 7 | 2.09 | 0.787 |
| 11 | Science teaching is better without the use of computers (N). | 12 | 21 | 3 | 2 | 3.13 | 0.777 |
| 18 | Computers will decrease the amount of teacher-pupil interaction in the classroom (N). | 10 | 16 | 8 | 4 | 2.84 | 0.945 |
| 19 | The only subject which should use computers is computer studies (N). | 14 | 18 | 2 | 3 | 3.15 | 0.861 |
| 22 | I think it is enough for pupils to study computer studies courses (N). | 10 | 18 | 8 | 1 | 2.99 | 0.775 |

* SA= strongly agree, A= agree, DA= disagree, SDA= strongly disagree, M= the mean and SD= standard deviation. # N= negative item

Scale mid-point= 17.5, item mid-point= 2.5, score mean= 20.30, score SD= 5.776

Note 1: The category values have been reversed for negative items, e.g SA replaces SDA and so on. M and SD were calculated after reverse.

Note 2: Missing values were calculated as equal 2.5

Table 10.6 Descriptive statistics of frequencies, means and standard deviations for the items of the VALUE scale

Similarly to the scale VALUE, Table 10.7 shows that almost all of the item-means in the scale ST.TRAINING were greater than the item mid-point (=2.5), the only item which did not achieved the item mid-point being item 2, "*There are not enough computer machines in the schools to be used for science teachers' training*". The highest item-mean in the questionnaire as a whole was item 10, "*It is possible for science teachers to be trained to use computers by their computer studies colleague*s". This would indicate strong agreement by computer studies teachers to train their science-teaching colleagues to use computers.

| No | Items | SA=4 | A=3 | DA=2 | SDA=1 | M | SD |
|---|---|---|---|---|---|---|---|
| 2 | There are not enough computers in the *schools to be used for science teachers'* training (N). | 5 | 7 | 6 | 20 | 1.92 | 1.12 |
| 3 | The only person who should control school computers is the computer studies teacher (N). | 9 | 18 | 7 | 4 | 2.84 | 0.916 |
| 6 | If I am to train my science colleagues in my school, then I need at least a year to do so (N). | 5 | 15 | 12 | 5 | 2.54 | 0.888 |
| 8 | It would be easy for me to train science teachers to use databases. | 11 | 17 | 6 | 1 | 3.04 | 0.766 |
| 10 | It is possible for science teachers to be trained to use computers by their computer studies colleague. | 22 | 14 | 2 | 0 | 3.53 | 0.603 |
| 13 | Science teachers are not capable of being trained to use computers (N). | 19 | 13 | 5 | 1 | 3.32 | 0.809 |

Table continue...

| No | Items | SA=4 | A=3 | DA=2 | SDA=1 | M | SD |
|---|---|---|---|---|---|---|---|
| 15 | I don't think that science teachers would like me to train them to use computers (N). | 8 | 26 | 3 | 1 | 3.08 | 0.632 |
| 16 | The computer studies teacher is the only person who should use the computers in his teaching (N). | 11 | 20 | 4 | 3 | 3.03 | 0.854 |
| 17 | Even if science teachers are trained to use computers, they will not be able to introduce pupils to computer applications (N). | 6 | 13 | 13 | 5 | 2.54 | 0.918 |
| 20 | I would be willing to train my science teacher colleague to use a computer in his teaching. | 18 | 15 | 4 | 1 | 3.32 | 0.775 |
| 21 | Students do not like any person to train them except the computer studies teacher (N). | 8 | 18 | 7 | 5 | 2.76 | 0.943 |
| 23 | I would be willing to allow my science teaching colleagues to use the computers. | 18 | 18 | 0 | 1 | 3.41 | 0.656 |
| 25 | It would be easy for me to train science teachers to use spreadsheets. | 10 | 21 | 4 | 2 | 3.04 | 0.774 |

* SA= strongly agree, A= agree, DA= disagree, SDA= strongly disagree, M= the mean and SD= standard deviation. # N= negative item

Scale mid-point= 32.5, item mid-point= 2.5, score mean= 38.36, score SD= 10.654

Note 1: The categories have been reversed for negative items

Note 2: The missing values were calculated as equal 2.5

Table 10.7 Descriptive statistics of frequencies, means and standard deviations for the items of the **ST.TRAINING** scale

The score-mean of the scale ST.TRAINING shown in Table 10.7 was also greater than its mid-point (38.5 > 32.5). This result shows positive attitudes throughout the scale.

| No | Items | SA=4 | A=3 | DA=2 | SDA=1 | M | SD |
|---|---|---|---|---|---|---|---|
| 5 | The computer studies teacher should meet with his science colleagues to discuss teaching ideas. | 21 | 13 | 2 | 0 | 3.45 | 0.686 |
| 9 | I would like my science colleagues to tell me about science teaching methods. | 12 | 24 | 2 | 0 | 3.26 | 0.554 |
| 12 | I think computer studies teachers are teaching well, so there is no need to train them how to teach (N). | 3 | 10 | 14 | 7 | 2.29 | 0.851 |
| 14 | A computer studies teacher does not need to be trained in teaching if he has enough knowledge of his subject (N). | 5 | 12 | 13 | 8 | 2.87 | 0.970 |
| 24 | There is no need to train a computer studies teacher to teach because he can get experience in the classroom (N). | 5 | 13 | 12 | 7 | 2.43 | 0.946 |

* SA= strongly agree, A= agree, DA= disagree, SDA= strongly disagree, M= the mean and SD= standard deviation. # N= negative item

Note 1: The categories have been reversed for negative items

Note 2: The missing values were calculated as equal 2.5

Scale mid-point= 17.5, item mid-point= 2.5, score mean= 20, score SD=4.00

Table 10.8 Descriptive statistics of frequencies, means and standard deviations for the items of the TRAINING scale

Table 10.8 shows that all of the 5 item means of the scale TRAINING were greater than the item mid-point. Item 5 shows the highest mean score (M=3.45), the item being, "*The computer studies teacher should meet with his science colleagues to discuss teaching ideas*". The scale mean of

20 was greater than the scale mid-point, and thus the score of 20 indicates strong positive attitudes toward computer studies teachers being trained in teaching methods.

It seems that almost all item-means and all of the scale score-means were greater than they had been expected to be (the mid-points). This indicates positive attitudes on the part of the sample generally toward the targets of the questionnaire as a whole. However, item 10 showed the most favourable response from computer studies teachers. This concerned the possibility of science teachers being trained in the use of computers by their computer studies colleagues. At the same time the scale concerning science teachers' training (ST.TRAINING), shows a large difference between its score-mean and its mid-point (38.36-32.5= 5.86). This would appear to confirm the willingness of computer studies teachers to train their science-teaching colleague to use computers. Further discussion about this point will be given in the next chapter.

## 10.4 Scale Reliability:

The data supplied by 38 computer studies teachers were used to estimate the sensitivity and the internal consistency of the CSTQ and its scales.

Table 10.9 shows that the 25 items of CSTQ gave a wide range of scores. More than 90% of the scale VALUE, 60% of the scale ST.TRAINING and more than 73% of the scale TRAINING, were covered by the responses of the sample. In addition, more than half the range of the questionnaire as a whole was covered by their responses.

| Scale name | No. Of items | Possible range of scales | | | Observed range of scales | | Mean score | Scale variance |
|---|---|---|---|---|---|---|---|---|
| | | Min. | Mid-point | Max. | Min. | Max. | | |
| **VALUE** | 7 | 7 | 17.5 | 28 | 9 | 28 | 20.30 | 18.51 |
| **ST.TRAINING** | 13 | 13 | 32.5 | 52 | 28 | 51 | 38.36 | 35.13 |
| **TRAINING** | 5 | 5 | 12.5 | 20 | 9 | 20 | 13.80 | 6.02 |
| **SUM** | 25 | 25 | 62.5 | 100 | 55 | 94 | 72.46 | 86.10 |

Table 10.9 Possible and observed ranges and score means for the three scales of computer studies teachers' questionnaire. Description of scales SUM also shown

The internal consistency (alpha) and the equal length Spearman-Brown ($R_{SB}$) were used to estimate the reliability of the questionnaire scales.

Table 10.10 shows all scales had significant reliability. Two scales had high reliabilities. The TRAINING scale had the lowest value; acceptable for a scale of only 5 items.

| Scale name | No. Of items | $\alpha$ | $R_{SB}$ |
|---|---|---|---|
| **VALUE** | 7 | 0.864 | 0.842 |
| **ST.TRAINING** | 13 | 0.806 | 0.826 |
| **TRAINING** | 5 | 0.557 | 0.562 |
| **SUM** | 25 | 0.835 | 0.795 |

Table 10.10 Scales reliability by using alpha and equal length Spearman-Brown. The reliability of the whole of CSTQ (SUM) also shown.

A total scale SUM of all 25 items showed higher reliability than two of the separate scales. The fact that $alph_{SUM}$ is not greater than alpha for all the separate scales individually indicates the scales do not measure closely similar constructs. This is confirmed by the inter-scale correlation which shows two weak negative relationships (Table 10.11).

| Correlations | ST.TRAINING | TRAINING |
|---|---|---|
| VALUE | 0.5556* | 0-.0320 |
| ST.TRAIN | | 0-.0420 |

* Sig. at 0.05

Table 10.11 scale correlation coefficients for the CSTQ scales and SUM

Table 10.12 shows that 16 of the 21 inter-item correlations for the items in the scale VALUE were significant at the 0.01 level or better. A typical item was item 1, "*Teaching science with the aid of computers will make science teaching easier*". This item was significantly related to all items of the scale indicating strong associations to the other items in the scale.

| Correlations: | 1 | 4 | 7 | 11 | 18 | 19 | 22 |
|---|---|---|---|---|---|---|---|
| 1 | 1.0000 | .5023** | .4247* | .5915** | .4719* | .3815* | .3996* |
| 4 | .5023** | 1.0000 | .2072 | .5610** | .3482 | .3667 | .4734* |
| 7 | .4247* | .2072 | 1.0000 | .3331 | .6739** | .2987 | .3784* |
| 11 | .5915** | .5610** | .3331 | 1.0000 | .5442** | .7379** | .5861* |
| 18 | .4719* | .3482 | .6739** | .5442** | 1.0000 | .5600** | .6609** |
| 19 | .3815* | .3667 | .2987 | .7379** | .5600** | 1.0000 | .5492** |
| 22 | .3996* | .4734* | .3784* | .5861** | .6609** | .5492** | 1.0000 |

1-tailed Signif: * - .01 ** - .001

Table 10.12 Item correlation for the scale VALUE.

Similar to the inter-item correlations of the scale VALUE, significant inter-item correlations were found between most items in the scales ST.TRAINING and TRAINING. The Tables are located in Appendix H.

The value of the complementary-alpha (i.e. the value of the alpha for scale if the item were deleted) was used to determine for each item in the three scales whether it should be removed from the scale.

The results of the complementary-alpha for all scales shown in Table 10.13 indicate that the complementary-alpha of each item in the scale VALUE was less than the alpha of the whole scale. In the scale ST.TRAINING, small improvement in alpha value could be obtained by removing item 2, which was the only item with a greater complementary-alpha value than the scale alpha value. The item was "*There are not enough computer machines in the schools to be used for science teachers' training*". It was also thought that the item is too important to the scale because many teachers interviewed in the preliminary study were of this opinion. (See Chapter Five.) For these two reasons, the item was retained in the scale.

| Item | complementary alpha | | Item | complementary alpha | |
|---|---|---|---|---|---|
| 1 | 0.849 | | 2 | 0.824 | |
| 4 | 861 | **VALUE** scale (7 items) | 3 | 773 | **ST.TRAINING** scale (13 items) |
| 7 | 862 | $\alpha$=0.864 | 6 | 793 | $\alpha$=0.806 |
| 11 | 829 | | 8 | 780 | |
| 18 | 831 | | 10 | 793 | |
| 19 | 844 | | 13 | 799 | |
| 22 | 838 | | 15 | 804 | |
| Total | 0.864 | | 16 | 797 | |
| 5 | 0.641 | **TRAINING** scale (5 items) | 17 | 782 | |
| 9 | 587 | $\alpha$=0.557 | 20 | 803 | |
| 12 | 270 | | 21 | 784 | |
| 14 | 507 | | 23 | 797 | |
| 24 | 352 | | 25 | 775 | |
| Total | 0.557 | | Total | 0.806 | |

Table 10.13 The complementary-alpha values for the three scales of the computer studies teachers' questionnaire (25 items)

Item 5 of the scale TRAINING decreased its alpha reliability from 0.641 to 0.557, while a further test showed removing both item 5 and item 9 would increase alpha value up to 0.732. However, these items were significantly related to the scale TRAINING (see inter-item correlations for the scale in Appendix H). This suggested that the two items may be not sufficiently homogeneous to the scale. There was some reluctance to drop these items for two reasons. First, they have good face validity for the scale, and second, the notion of training is central to the interaction of STTs and CSTs. Consequentaly, the scale was treated with and without these item, i.e. the scale analysed as TRAINING (5) with these items, and TRAINING (3) without these items.

It can be concluded that both of the previous tables suggest acceptable reliability for each individual scale. The scales VALUE and ST.TRAINING showed high reliability values, while removing two items from the scale TRAINING give further improvement to its reliability.

The scales VALUE, ST.TRAINING, and two forms of the scale TRAINING will be used in the next part of this chapter to look for relationships between the variables included in the computer studies teachers' questionnaires.

## 10.5 Relationships between Variables:

Computer studies teachers' characteristics were divided into two categories: the first was personal characteristics, including: subject, qualification, Education Diploma, years of experience and ownership of personal computer. The second covered previous training, including: training on database, spreadsheets, wordprocessor, computer networks, attending courses in teaching methods and attending courses related to use of computers in teaching.

To investigate whether groups formed according to the characteristic variables had different attitude scores, t-tests were carried out between scores of the groups on the three attitude scales of VALUE, ST.TRAINING and TRAINING.

Because similar results were found for the scale TRAINING with 5 items, 3 items and for the items 5 and 9 individually, the relationships presented in the next sections were for the scale as a whole, i.e. with combining all 5 items together.

### 10.5.1 Relationship Between Samples Characteristics and Attitude Scales:

Table 10.14 summarises the relationships between the CSTs personal characteristics and their attitude scores on the three scales.

The t-test results shown in Table 10.14 indicate insignificant t-values, which means that there are no true relationships between CSTs personal characteristics and and scales VALUE, ST.TRAINING and TRAINING measuring their attitudes to: the value of computers for science teaching; toward training their science colleagues to use computers; and toward their own training in teaching methods. Among the variables, 'Subject' showed the highest t-value to the scale VALUE.

| Scale | | | VALUE | | | ST.TRAINING | | | TRAINING | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Character | Groups | N | Mean | SD | t-value | Mean | SD | t-value | Mean | SD | t-value |
| Subject | Educational | 8 | 22.69 | 3.56 | 1.63 | 39.38 | 6.11 | 0.54 | 14.19 | 1.89 | 0.54 |
| | Non-Edu. | 30 | 19.96 | 4.31 | | 38.05 | 6.13 | | 13.64 | 2.66 | |
| Qualification | Educational | 9 | 21.61 | 4.30 | 1.05 | 39.11 | 5.73 | 0.43 | 13.89 | 1.88 | 0.12 |
| | Non-Edu. | 29 | 19.90 | 4.30 | | 38.12 | 6.07 | | 13.78 | 2.63 | |
| Had Edu. Diploma | Yes | 4 | 22.13 | 4.80 | 0.88 | 40.38 | 3.82 | 0.70 | 13.87 | 1.32 | 0.11 |
| | No | 33 | 20.09 | 4.33 | | 38.12 | 6.22 | | 13.73 | 2.58 | |
| Years of Exp. | 0-5 | 30 | 20.35 | 4.49 | -0.28 | 38.12 | 6.12 | -0.63 | 13.93 | 2.62 | 0.55 |
| | 6+ | 7 | 20.86 | 3.42 | | 39.71 | 5.71 | | 13.36 | 1.86 | |
| Ownership of PC | Yes | 31 | 20.68 | 4.55 | 0.83 | 38.73 | 1.07 | 1.02 | 13.95 | 2.58 | 1.18 |
| | No | 6 | 19.08 | 2.54 | | 36.00 | 6.20 | | 12.67 | 1.40 | |

Table 10.14 Result of t-tests for the scales **VALUE, ST.TRAINING, TRAINING** and groups formed accorded to personal characteristics.

### 10.5.2 Relationship Between Sample Previous Training and Attitude Scales:

Table 10.15 summarises the relationship between the previous training of CSTs and the scales VALUE, ST.TRAINING and TRAINING respectively.

The only significant variable among all previous training variables was training on computer networks 'Net.'. A t-value of 2.39 was achieved, more than 0.05 level of significance. Some variables, however had visible, but insignificant t-values.

| Scale | | | VALUE | | | ST.TRAINING | | | TRAINING | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Character | Groups | N | Mean | SD | t-value | Mean | SD | t-value | Mean | SD | t-value |
| DB* | Yes | 32 | 20.88 | 4.32 | 1.32 | 38.67 | 6.11 | 0.00 | 13.58 | 2.56 | -0.50 |
| | No | 3 | 17.50 | 2.50 | | 38.67 | 2.51 | | 14.33 | 1.16 | |
| SS | Yes | 23 | 21.39 | 4.81 | 1.34 | 40.22 | 6.13 | 2.01 | 13.91 | 2.52 | 0.56 |
| | No | 11 | 19.32 | 2.45 | | 36.14 | 3.99 | | 13.41 | 2.28 | |
| WP | Yes | 35 | 20.66 | 4.29 | 1.43 | 38.27 | 6.14 | 0.05 | 13.73 | 2.52 | -0.15 |
| | NO | 2 | 16.25 | 1.77 | | 38.50 | 3.54 | | 14.00 | 1.41 | |
| Net. | Yes | 11 | 22.86 | 4.77 | **2.39** | 40.68 | 7.52 | 1.55 | 14.23 | 2.96 | 0.78 |
| | NO | 25 | 19.32 | 3.78 | | 37.36 | 5.13 | | 13.52 | 2.29 | |
| TCo | Yes | 12 | 20.88 | 4.38 | 0.67 | 20.88 | 4.38 | 0.67 | 13.08 | 3.03 | -1.22 |
| | No | 24 | 19.88 | 4.11 | | 19.88 | 4.11 | | 14.15 | 2.13 | |
| CTC | Yes | 31 | 21.90 | 1.75 | 0.98 | 38.52 | 5.69 | 1.38 | 38.52 | 5.69 | 1.38 |
| | NO | 5 | 19.94 | 4.39 | | 34.70 | 5.91 | | 34.70 | 5.91 | |

* DB= had training on database, SS= had training on spreadsheet, WP= had training on wordprocessor, Net.= had training on computer networks, TC= attended courses in teaching methods and CCT = attended courses related to use of computers in teaching.

Table 10.15 Result of t-tests for the scales **VALU, ST.TRAINING, TRAINING** and groups formed accorded to previous training

## 10.6 Discussion:

This chapter showed that there were three reliable scales in the CSTQ, namely: VALUE, ST.TRAINING and TRAINING. Very high reliability was recorded for each individual scale. Alpha was recorded 0.86, 0.81 and 0.73(0.56) for scales and modified scale respectively.

The data supplied by 38 CSTs showed strong positive attitudes among the sample toward: the value of computers for science teaching (VALUE), training their science colleagues to use computers in their science classrooms (ST.TRAINING) and their own training in teaching methods

(TRAINING). The item-means recorded by their responses indicated that almost all items were scored higher than item mid-point, which was expected as a mid response.

The results presented in the previous two sections showed that the only related variable was previous training on Networks with the scale VALUE. 32 of the 33 t-tests for the three scales were not significant, indicating lack of significant relationships between computer studies teachers' personal characteristics and their previous training, and their attitude scores on the three scales. The finding of one value from 33 testes can be dismissed on the ground that this is no more than simple statistical expectation.

Two reasons could explain the lack of significant findings for the CSTs. First, 38 cases of the computer studies teachers is not a very large sample. Difficulties were compounded by the uneven split across the variables with, often, very few cases in one of the groups. A very small sample for one group makes it too difficult for the t-test to detect the difference if any, between the two groups. The importance of sample size in statistical tests is well known. McNemar (1969) pointed out that the greater the number of cases, the greater the likelihood of detecting a difference. The results of CSTs showed two group sizes for each variable, a small group and large one. In each test of the personal characteristics, there were 9 cases or less in each of the smaller groups. In the previous training section also, small groups were revealed for about half the variables.

The results of the sample on 'previous training' indicated that t-value was mostly increased as the number in the smaller group increased. For example, it was 0.00, 0.05 and 1.38 when the smaller group was 3, 2, and 5 in the variables: DB, WP and CCT respectively. But it was 2.01, 1.55 and 0.67 when the smaller group was 11, 11 and 12 in the variables: SS, Net. and TC respectively. Although these scales are not significant, they do support indications of restrictions from group size.

Second, the means of both CSTs groups were very close to each other. This indicates the similarity of attitude between the two groups. All CSTs had the same favourable and sympathetic attitudes to the variables measured by the three scales.

# CHAPTER 11 : :

# DISCUSSION AND SUMMARY

The main aim of this study was to consider possible problems which may arise when computers are used for science teaching in Saudi Arabian secondary education.

This chapter concerns some problems facing the introduction of computers into secondary school science teaching. It summarises the findings obtained from the 266 science teachers, 15 science advisors, 16 science trainers and 38 computer studies teachers. Computer background of the STs, STAs and STTs, and the attitudes of all samples toward the introduction of computers for science teaching are also described.

The following sections bring together the problems, issues and findings detected by this study, from the literature review, experience of some industrial countries, and from empirical fieldwork in Saudi Arabia.

## 11.1 Funding Issue:

Although funding is a major issue to be considered in educational programmes, the enthusiasm shown for computers by the Saudi Arabian government and its Ministry of Education, leaves little doubt that the introduction of computers would not face any funding difficulty.

The problem which may arise here is the allocation of the funds between different parts of the programme. At present, most funding goes to support computer equipment and machines, whilst little if anything has been spent on teachers' training programmes and software development. The correctly balanced distribution of the fund will provide both machines and other services to ensure they are used to full benefit for students.

## 11.2 Hardware Issue:

The preliminary study (Chapter 5) showed that 16 computer machines are based or intended to be based in each secondary school. This number is close to the number of machines per school in some industrial countries, where computers are used in teaching of almost every subject. Moreover, the Saudi Arabian government is continuing its programme of installing machines in the schools (see Chapter 1).

One recognizable hardware problem which could face the introduction of computers in secondary school science teaching may arise from the type of machines installed in schools. The preliminary study showed that schools have MSX 350 computers. These machines are supplied by Alalamia computer company. The majority of these machines can work only with specific types of software produced by the company, partly because they are bought for programming purposes only.

Lewis (1989) and NCET (1993) have both stated that lack of versatility of the BBC computer machines was a serious crisis in British schools in the late eighties. Similar problems, therefore could be expected in Saudi Arabia if the Ministry of Education continues to install MSX machines. It has been opined that installing standard types of computer such as IBM-PC and its compatible, Apple Macintosh, is the best way of avoiding problems arising from incompatibility between hardware and software. Standard types are usually easy to use, cheap to buy and a wide range of compatible software can be found and used.

### 11.3 Software Issue:

This problem is shown through: shortages of programs related to science subjects, high price of science software, etc..

There is a lack of Arabic computer software for science subject teaching in Saudi Arabia, although some private companies have established "Microtext" programs for some science subjects. The price of these programmes is too high. The reason for shortages and the high price of software related to science subjects is probably linked with the use of non-standard MSX computers.

The difficulties of producing specific software to assist science teaching has led some educators in the industrial countries to think about using types of generic software such as: Wordprocessor, Database and Spreadsheets (see Chapter 6). The recognition of the potential of these types of software in science teaching can seen by the rapid increase in their use throughout English and American schools.

The lack of Arabic educational software gives additional support to call for the use of generic software in science teaching in Saudi Arabian secondary schools. These types of software are widely available in the Saudi Arabian market at economic prices.

In 1992, Microsoft and Alalamiah companies have both launched Arabic versions of Micrsoft Windows release 3.0 and 3.1. This facility can easily translate any Windows-applications into Arabic. In addition to command translation, Alalamiah copy provides an "Arabic Interface", which gives the user complete control over the applications (Figure 11.1). It states:

"This version provides all that you need through the Arabic Interface for all Windows Latin applications. You could easily replace any Latin Interface by an Arabic one". (Al-alamiah Manual, p. 1)

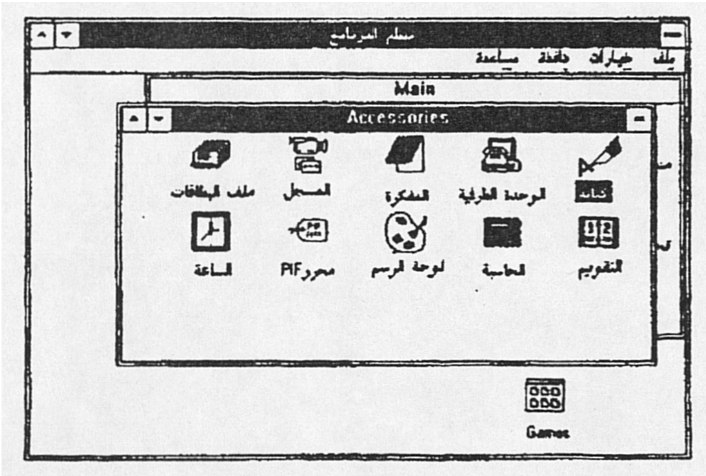



Figure 11.1 Al-alamiah Arabic Windows

Recently, Microsoft has announced that it will provide an Arabic version for every Microsoft application within 90 days after its Latin release, "We are considering to establish a Microsoft manufacture in Saudi Arabia because 80% of our sale in the Gulf is based in Saudi", said the Microsoft Dealer in the middle east (Al Riyadh, 1993).

Arabic windows could provide schools with a wide range of generic software applications in Arabic such as Lotus 1,2,3, DataEase, etc., although some generic applications such as Excel and Word have already provided Arabic versions.

Regardless whether schools choose an Arabic application or a translated Arabic application, there is no doubt that science teachers will find them much easier than establishing new software for every science topic.

## 11.4 Samples' Computer Knowledge:

Eight computer knowledge items were included in both the STQ and STTQ. Each of the three samples (i.e STs, STAs and STTs) found item 2, "*Computers are used to introduce large amounts of information to pupils*" the easiest item, as it was very general. The majority in each sample gave correct responses to this item.

Items 6 and 7 were found the most difficult. Item 7 was, "*The Saudi Arabian market has various examples of English software, but almost nothing in the Arabic language*". The item was intended to investigate the samples' awareness of the Arabic commercial applications of the computers. Only subjects who used or were aware of computers were expected to give the correct response. Responding correctly to this item could be linked to the ownership of a PC, because the preliminary study showed most of the sample who had PCs were found to use them for Arabic applications (see Chapter Five). The 30.8 %, 43 % and 40 % of STs, STAs and STTs respectively who gave the correct response to the item corresponded closely with the 33 %, 26.7 and 28.6 who had PCs.

Item 6 was, "*The use of the PC is unrelated to the needs of the schools*". Since this item was intended to assess advanced computer knowledge and the misunderstanding of the needs of the schools, only a minority of subjects disagreed with the item. 22.6 % of STs, 33.3 % of STAs and 46.7 % of STTs responded correctly to this item.

Although only basic knowledge was involved in many of the items (see Table 7.10), the majority of both STs and STAs could not give the correct answers to most of the items. This confirmed the preliminary study findings of lack of knowledge and background of use of computers in classrooms among the samples. The results from STTs also showed somewhat limited computer knowledge.

This limitation of computer knowledge may perhaps be attributed to the lack of computer literacy courses in the Saudi Arabian education sector. For example, 78 % of STs, 85 % of STAs and 69 % of STTs had no computer experience. Moreover, 76 % of STs, 64 % of STAs and 75 % of STTs had not attended computer courses at all, while 95 % of STs and 79 % of STAs had not attended a computer course specifically related to the use of computers in teaching.

## 11.5 Samples Attitudes Toward the Introduction of Computers into Science Teaching:

Each of the four samples, i.e. STs, STAs, STTs and CSTs showed strongly favourable attitudes toward the introduction of computers into the science classroom.

### <u>11.5.1 Science Teachers' and Advisors' Attitudes:</u>

In the STs results, the item-means were greater than the item mid-point in all of the items making up the three reliable attitude scales, except for items 6 and 20 (Tables 8.13 to 8.16). These items were, "*Science teachers manage without computers, so computers are not really necessary*" and "*The use of computers in science teaching would require large changes in science teaching methods*". The agreement with these two items can be explained on the ground of lack of computer knowledge among the sample, especially for item 20. Some teachers might have thought that the introduction of computers in science teaching really needs a great change in teaching methods, because they had little knowledge of the nature of computers and their use in science teaching, although they might still have a favourable attitude. For example, 14 out of 17 science teachers interviewed in the preliminary study had no idea about using computers to aid science teaching.

Although STs' data showed that half the item means in the scale TRAINING were less favourable than the item mid-point, these items were generally stated less directly as positive (or negative) than those where item-means were higher than item mid-point. For example, item 24 (item-mean was lower than item mid-point), " *A teacher of computer studies is not the best person to train science teachers to use computers*", and item 11 (item-mean was lower than item mid-point), " *Science teachers must know a great deal about computers if they want to use them in science teaching*" were not directly worded, whereas item 14 "*I would like my computer* studies colleague to train me to use a computer in *my teaching*" reflected more clear opinions. Some respondents therefore for some reason(s) disagreed that the computer studies teacher was the best person to train them, although they were willing to be trained by him, as they stated in item 14. Some who answered to the best of their knowledge, that the science teacher needs a great deal of knowledge about computers before he uses them, were not reflecting their unwillingness to use computers, but their lack of knowledge as to how easy or difficult computers are.

The highest item-mean among the TRAINING items was for item 3, "*A computer training programme should be compulsory for every science teacher*". The high score for this item (mean=3.07) indicates that science teachers are extremely willing to be trained to use computers in their teaching.

Although STAs findings showed rather less favourable attitudes than those of STs, 22 of the 30 item-means were greater than item mid-point (Tables 8.13 to 8.16). The similarly unfavourable attitudes to some items of both STs and STAs could confirm the previous assumption that the strength of attitudes implied by the wording of the statements accounted for these responses.

**11.5.2 Science Teacher Trainers' Attitudes:**

Part B of Chapter 8 has discussed how 24 attitude items were used to estimate science trainers' attitudes toward the introduction of computers for science teaching. Strong positive attitudes were found among the sample for all items. Only three item-means were less than the item mid-point. The three items were 17, 9 and 14. Items 17 and 9 were identical to items 20 and 11 respectively in the STQ; therefore additional support for the explanation effected previously is obtained here. Item 14 stated, "*Even if a science teacher knows to use a computer for personal home use, he will still require to be taught how to use it in the science classroom*". Not all of the sample were expected to recognize the statement, because it was intended to measure the STTs' opinions on the science teachers' training and how difficult or easy they perceive a training programme.

### 11.5.3 Computer Studies Teachers' Attitudes:

The computer studies teachers' questionnaire involved 25 attitude items. More than half of the items were directed to assessing the computer studies teachers' attitudes toward training science teachers to use computers in their science classrooms.

Tables (10.6 to 10.8) showed that 21 of the 25 item-means were greater than item mid-point indicating strongly favourable attitudes among the sample. 12 out of 13 items directed to investigating computer studies teachers' attitudes toward training their science teacher colleagues to use computers in their classrooms achieved greater than item mid-point, showing the willingness of computer studies teachers to train science teachers. The only item which had a mean lower than the item mid-point was item 2, "*There are not enough computers in the schools to be used for science teachers' training*". This result perhaps indicates that computer studies teachers thought that training science teachers will require a long time, because 17 CSTs out of 37 were agreed to the item 6, "*If I am to train my science colleagues in my school, then I need at least a year to do so*". They might, therefore expect science teachers to need to use school computers every day throughout the year. And this, they might have thought, would need more machines.

## 11.6 Variable Relationship Findings:

### 11.6.1 Variable Relationships of Science Teachers and Advisors:

Both samples of science teachers and advisors responded to the STQ containing the scales of, VALUE, BENEFIT and EFFECTIVE, and also 8 individual TRAINING items. After factor analysis, the items of the three scales were loaded onto two reliable factors, IMPORTANT and PROBLEM. The relationships were carried out between scales, factors, TRAINING items and the variables of characteristics, knowledge and activities (STs only) of the two samples.

Section 9.1 has shown that the ownership of a PC was the strongest effective variable among STs attitudes. 'Years of experience' and 'attendance on a course in the use of computers in teaching' also had significant relations with one or more scales. The study showed no significant relationship between STs' characteristics and TRAINING items.

There are three possible explanations for the significant relationship obtained with the ownership of a PC. One possibility is that science teachers' favourable attitudes led them to buy PCs; second, that the ownership of PCs made them more favourable toward the introduction of computers; and third that both variables (attitudes and ownership of PC) influence each other.

The significant relationships between some science teachers' characteristics and the scales and factors could suggest that their attitudes were affected by computer experience, because the ownership of a PC, and attending a course in the use of computers in teaching would all increase computer experience. Many studies however, have claimed the influence of personal computer ownership, computer knowledge and experience upon attitudes toward the use of computers. (See section 4.3.)

The importance of computer background, discussed earlier in this chapter is confirmed by the findings of the knowledge relationships. Half of the knowledge items were significantly related to STs' attitudes. The strongest significant statements were items 2, 3, 4 and 5, concerning *"Computer to introduce information"*, *"Computer applications in science"*, *"Need to be a programmer"* and *"Change within computer typing"*, respectively. In all 24 knowledge relationships between knowledge items and scales, the means of the Correct groups (the teachers who responded to the knowledge items correctly) were greater than those of the Wrong groups (the teachers who responded to the items incorrectly). This means that the Correct groups had more favourable attitudes than the Wrong groups. In other words, teachers with greater knowledge had more favourable attitudes. Although correlation is not evidence of causation, the balance of probability seems to favour an increase of teachers' knowledge improving their attitudes.

The 8 science teachers' activities in the STQ were intended to assess the influence of science teachers' classroom activities on their attitudes toward the introduction of computers in their science teaching. The findings showed that only activities related to computers were significantly related to science teachers' attitudes. These activities concerning *"Computer articles"*, *"CT meeting"*, *"IT news"* and *"Visits"*. Teachers who claimed to read educational computing articles to look for teaching ideas -*Computer articles*- had the strongest favourable attitudes among the science teachers' sample. That means, among the teachers who were interested in computing (those who were active in the activities related to computers), there is one group (those who were reading computer articles only to look for teaching ideas) who had the most favourable attitudes.

Unlike science teachers, science advisors showed little, if any, sign of significant relationships between their personal characteristics and computer knowledge and their attitudes toward the introduction of computers into science classroom. (Another discussion of the lack of group discrimination will be presented later in this chapter).

**11.6.2 Variable Relationships of Science Trainers:**

Part B of Chapter 9 has explained how three reliable attitude scales and six individual items were used to measure the science teacher trainers' attitudes toward the introduction of computers for science teaching. Relationships were investigated regarding the interrelations of the attitude variables with 9 personal characteristics and 8 knowledge items (identical to STQ items). Although weak relationships were found among the characteristic variables, the ownership of a PC appeared as the only strong relating characteristic variable. Reading articles about wordprocessors (WP) also showed some significant relationships with some scales and items. The knowledge item 1, "*Computer can be used as private tutor*" was the only item which showed an obvious significant relationship to some attitude scales and items.

The most obvious discrimination between characteristic and computer knowledge groups appeared with the scale TRAINING. Half of the 8 personal characteristics were significantly related to the scale at a significance level of 0.1 or less. Trainers who answered "Yes" to the variables, "*WP*", "*PC*", and "*CExp.*", and who had more years of "*Experience*", had more positive attitudes toward their own training on use of computers in their teaching. The scale was intended to assess STTs' willingness to use computers in their teaching, in other words, their willingness to train science trainees to use computers in the pre-service training programme. The studies describes made to identify variables which might affect such willingness. Three of the variables were those that could increase computer experience. This findings gives additional support to the influence of computer experience on the subjects' attitudes.

### 11.6.3 Relationships of Computer Studies Teachers:

Six personal characteristics and six previous training variables were analysed in relation to computer studies teachers' attitudes. The findings of the relationships between the various variables and the three reliable attitude scales, VALUE, ST.TRAINING and TRAINING, showed an almost complete absence of significant relationships between the variables and the attitudes. The only related variable was between previous training on Networks, and the scale VALUE. Two possible reasons for the lack of significant relationships were given at the end of Chapter 10.

### 11.6.4 Lack of Discrimination Between Groups in the Findings:

It is obvious from the study findings that, although strongly favourable attitudes toward the introduction of computers in science teaching were found among the four samples, no discrimination between groups was found in most of the relationships within individual samples. The lack of discrimination between groups can be attributed to the following reasons:

First, some samples were very small, especially STAs, STTs. The number of the CSTs was also not very large. The importance of sample size in statistical tests was fully explained at the end of Chapter 10. However, more evidence of the importance of sample size could be obtained from the increase of discrimination by the test used for the STs sample, where 266 cases were included.

Second, difference between groups in one or more aspect does not always influence the results relating to other aspects of the subjects. Youngman (1979) pointed out that many treatments often have little effect on the final results and interpretation. This is even more likely when, as in the present case, the subjects' attitudes are already highly positive.

Thus, it was impossible for a statistical test such as t-test to detect any discrimination between the attitudes of science teacher who had attended computer courses (for example) and others who had not.

Third, and perhaps most important, differences in the groups' backgrounds are very important for the discrimination of the results. The classification tests used in social science and education were developed from the applied sciences where obvious group discrimination exists. Differences between groups can only be detected if there are enough grounds of classification, for example: acid and alkali, reptiles and birds, male and female, young and adults. In a study of attitudes, relevant distinguishing criteria include males and females, those who have computer qualification and those who do not, those with a PC and those without, those often using computers and seldom using computers, etc.

The preliminary study and the demographic data in the main study indicated only slight background differences among the STs' sample. They had almost similar computer knowledge background and experience. Science teachers had had neither computer training programmes, nor real computer courses (some of them had attended courses lasting a day or so), few of them had attended a course in the use of computers in teaching, and some of them were not active (according to the eight activities discrimination) because of the lack of facilities available. Moreover, the main field work shows strong favourable attitudes among all subjects. The expectation, then, was of few variables that would detect differences between the groups of the sample. For example, because ownership of the

PC is an obvious difference, the attitudes of science teachers who had PCs and those who had not were distinguishing among the sample, but the attitudes of experienced and new science teachers were found to be similar, as neither had any computer training in their qualification programmes.

## 11.7 Lack of Computer Background and Experience:

The findings of this study indicated lack of computer knowledge and experience among STs, STAs and STTs. The importance of computer knowledge and experience for improving attitudes toward computers and for using computers was confirmed by many studies. Underwood and Underwood (1989) found that teachers' negative attitudes to use of computers in school were related to low computer awareness. They found it encouraging that those who rejected the computer based their opinions on limited computer knowledge. Turkel and Chapline (1984) found that increasing teachers' knowledge about computers could foster positive attitudes toward computers and their use in schools.

The lack of computer knowledge and experience among Saudi Arabian science teachers could create a serious difficulty for the introduction of computers into science teaching. Many subjects claimed to suffer from this problem: "*I could not give any comments, because I do not have any computer knowledge and I was not provided with any computer courses*", one subject stated. Many subjects said that they will not use computers in their teaching unless they first have opportunities to obtain computer experience.

Providing computer knowledge and awareness among the school staff in Saudi Arabia could encourage science teachers to adopt more favourable attitudes toward the use of computers in their own classrooms. It could also encourage them to attend computer courses inside and outside their schools. The solution to this problem could be linked with the solution of more general problems of teacher training.

**11.8 Teacher Training Issue:**

Chapter Four has indicated that one of the most serious difficulties facing the introduction of computers to schools in industrial societies is teacher training.

The findings of this study indicated a real need for computer training programmes in Saudi Arabian secondary schools. 21 of 73 respondents, i.e. 33.3 % who gave comments on the science teachers' questionnaire, called for "Training first". For example, subject 96 stated, "*Before we introduce computers into the science classroom, we should think carefully about the teachers' training programme*". Subject 193 also claimed that "*The most important key to the introduction of computers in science teaching is teachers' training*". A science trainer stressed that science teachers will not use computers unless they are provided with adequate training. One possible solution to this important problem will be suggested in the following chapter.

# CHAPTER 12::
# AN APPROACH TO COMPUTER TRAINING FOR SCIENCE TEACHERS IN SAUDI ARABIA

The aim of this chapter is to propose a model for an INSET programme to be used with science teachers in the field, as well as a pre-service programme for science teacher trainees. The locations of the responsibilities for the programmes are also indicated.

## 12.1 Introduction:

Teacher training is the crucial issue to be addressed for the successful introduction of computers in schools. It currently receives considerable attention in the developed countries. Terry (1984) pointed out that:

> "The training of teachers across all subject areas in the curriculum to use the microcomputer effectively in the teaching of their subjects represents one of the largest problem areas and is essential if microcomputers are to achieve their considerable potential in schools." (p. 7,8)

In October 1988, the UK secretary of State set up an IT in ITT Expert Working Group whose terms of reference were:

> "To identify current best practice in preparation of trainee teachers for the use of information technology in schools in all areas of the curriculum and to make recommendations for the development, within the time and other resources available, of initial teacher training to ensure that all trainee teachers acquire the appropriate knowledge and skills in information technology and competence in their professional application in the classroom." (DES, 1991, p. 1)

The report of the Expert Working Group, the Trotter report, was published in March 1989 and one of the recommendations was that "It should be a condition for the approval by the Secretary of State of any course of ITT that it includes training to provide students with at least a specified minimum IT capability." (DES, 1989c, p. 19)

The first strategy for teacher training is to develop adequate in-service and pre-service training programmes for teachers and teacher trainees (Duguet, 1990).

Development of pre- and in-service courses that enable and encourage teachers to use computers is no small task (Langhorne, et al. 1989). The courses should be designed to give teachers the specific skills they need to use computers in their classrooms successfully, in order to meet appropriately the needs of their pupils. Any approach should take into account the background of teachers and advisors as well as trainers.

The absence of computer-based subject awareness among Saudi Arabian science teachers and educators requires an extensive approach for in-service training. The need for pre-service training in the use of computers is also important to avoid computer illiteracy among new science teachers.

The Saudi Arabian Vice Assistant Minister for Educational Development has stated that the computer curriculum will be replaced by a new one similar to those found in the developed countries. "*It will start where the others left off*," he added. He went on to say that the Ministry of

Education has not yet set up a training plan which would enable subject teachers to use the computer facilities available in the schools, as subject teachers in developed counties are doing[1]. (See the interview in Appendix G). He emphasized however, that "We are still considering how and in which subject we can start".

Therefore, it seems that the current period is the right time to consider a training programme, whereby subject teachers will be able to undertake in-service computer-based subject training in order to enable all teachers to use information technology as part of their daily lessons.

Chapter 1 has shown that science subjects have been accorded one of the highest priorities in Saudi Arabian secondary education. Science teaching involves the largest number of secondary school teachers. If science teachers are encouraged to undertake computer-oriented INSET and the programme is successful, then the training framework used for science teachers can be used afterward as a pattern for a comprehensive approach to release all secondary school subject teachers throughout the country to participate in an INSET programme. This would facilitate the use of information technology across the whole secondary school curriculum.

## 12.2 Selecting Training Objectives, Content and Components:

Stetcher (1984) found a number of aspects of course design which are important for in-service information technology courses. These are:

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1. See some of the industrial strategies in Duguet, 1990.

- placing emphasis on "hands-on" computer time with a focus on integrating the computer into the teaching process;
- developing clear goals and objectives and incorporating assignments which prompt teachers to use the software in their classroom;
- including activities which encourage interaction and sharing of information;
- making participation on the course voluntary;
- selecting course tutors who have experience of the software.

### 12.2.1 Objectives:

For any educational programme, clear objectives should be set before implementation. As with other teaching programmes, the least effective forms of INSET are likely to be those courses and activities where the aims and objectives have not been clearly identified and matched to the needs of individuals and their instructors. After their six-month study of the strategies being used by LEAs and schools to enable teachers to undertake INSET, the report of the National Foundation for Educational Research (NFER) stressed that INSET was seen as most successful when it resulted from a clear analysis of needs and was likely to be custom-designed rather than off-the-shelf. It was stated that teachers themselves regarded INSET as being effective when there was a degree of match between their level of experience and the content of the course (DES, 1990). The objectives of the INSET for Saudi Arabian science teachers, therefore, will use all findings and information obtained from science teachers, advisors, trainers and computer studies teachers in order to set up appropriate objectives suited to their knowledge, experience and attitudes. The computer facilities existing in the secondary schools will also be considered.

However, there are many issues which will influence and guide the formulation of objectives for the current INSET programme, such as: the findings of the preliminary and main field studies; the experience of some industrial countries; and the current and future policies regarding use of computers in Saudi Arabian secondary education.

The following objectives are considered appropriate for the INSET approach for Saudi Arabian secondary school science teachers:

a) **To improve science teachers' computer awareness:** At this stage teachers should have general information about computers; they should become *"computer literates"*.

b) **To improve science teachers' personal confidence in using computers:** Teachers should feel confident to use computers for their own purposes, e.g, record-keeping, preparing lesson plans, course procedures.

c) **To make appropriate use of computers in science classrooms:** Teachers should be able to choose and make practical use of computer generic software in science lessons.

d) **To collect ideas from science teachers which could improve use of computers in the science classroom:** Teachers should be encouraged to reflect on their own experiences in their lessons. These reflections should be used to improve both the choice of software and methods of using them. Teachers' ideas and experiences should be shared with others for the benefit of the whole system.

e) **To make effective evaluation of computer software related to science subjects:** At this stage teachers should be requested to deliver their own evaluation of using some software in the classroom.

The following section gives further explanation and examples of these objectives.

### 12.2.2 Content:

On the basis of the training programmes and strategies discussed in Chapter 4, and in accordance with the level of computer knowledge and experience found by this study among Saudi Arabian science teachers, the training approach should cover the following aspects:

#### 12.2.2.1 Basic Training:

Many studies have shown that improvement in teachers' computer awareness is strongly related to their attitudes and participation in computer training programmes (see section 4.3 in Chapter 4). Therefore, the first step should be basic training linking to computer awareness. This will include basic principle of using a computer, such as: how to switch the machine on and off, distinguishing between the software options, understanding computer facilities, using Windows/mouse, typing and printing with one wordprocessor, creating and saving a file, using a printer, etc.

At this stage teachers should be advised to use only one type of wordprocessor in order to reduce the time and effort required to become confident.

### 12.2.2.2 Familiarisation and Personal Confidence Training:

The next stage includes training teachers to use computers for their own purposes. For example, they could use them for pupils' records, lesson plans, writing and recording examinations, etc. Wordprocessors are the most appropriate software for this type of training, being relatively simple to master, yet at the same time doing these jobs effectively.

Teachers should be encouraged to use computers regularly. For example, writing a plan for each daily lesson is compulsory for every science teacher in Saudi Arabia. It would be useful if the teachers were required to write their plans by using a wordprocessor. This would require them to use computers almost every day. If this practice were adopted, teachers' confidence would quickly be greatly increased, because the fact that many users are performing the same activities would give a feeling of mutual support.

One idea which is thought worthy of consideration is to provide one or two computers and a printer in the staff room(s); this would encourage teachers to use computers in their spare time. It would also be useful if the teachers were required to keep their pupils' records in the staff computer. The Ministry of Education could play an important role here by deciding these requirements for all teachers throughout the country.

#### 12.2.2.3 Training in the Use of Computer Applications in the Science Classroom:

Various generic types of computer software are available in the Saudi market today, such as database and spreadsheet. Science teachers should be given confidence to apply these in their classrooms.

Chapter 6 has shown that databases and spreadsheets are powerful tools for science subjects. Therefore, science teachers should be trained how can they use them in their classrooms successfully as part of the INSET programme. Teachers would be shown some examples of applications of these tools to topics from the science curriculum.

#### 12.2.2.4 Training in the Evaluation of Teaching with Computer Software:

The training programme should include guide-lines, methods and criteria for evaluating the application of software in science teaching. An objective evaluation given according to an agreed common format could be accompanied by comments and personal questions to the teachers about the quality of the software and its validity for improving science teaching and pupils' experience.

Teachers should be asked to offer their opinions and ideas and to keep notes, etc., on how they have used the software in order to discuss them in regular meetings throughout the programme.

### 12.2.3 Hardware:

Only half of the US secondary schools have fifteen or more computers (Woerner, et al. 1991). A similar number is based in every UK secondary school (Lewis, 1992). By 1992-1993, each Saudi Arabian secondary school will have at least sixteen computers (see Appendix G). The recent installation of computers has given the Ministry of Education the opportunity to install better and more powerful machines, because of the rapid fall in market price and rapid increase in computer power.

The installation of more machines in the schools will make the provision of computer facilities in Saudi Arabia on a par with, or even better than that in USA and UK. Therefore, similar uses of computers in Saudi Arabian schools will not be held back or restricted by any hardware problem. The availability of large numbers of newer, more powerful computers in Saudi schools will <u>not</u> <u>guarantee</u> <u>better</u> <u>use</u> of computers, but provide the <u>potential</u> for it. It is the time now for the Ministry of Education to think carefully about how schools, teachers and students can get better use from these valuable facilities.

### 12.3 Initial Preparation of Science Teachers:

The nature of Saudi Arabian science teachers requires careful planning of course content and timing before the training programme is implemented. Teachers need initial computer literacy to not disappoint the high positive attitudes held toward training in the use of computers. The training course should take into account the lack of computer literacy among science teachers and in the whole Saudi Arabian society. Although Saudi Arabia is moving now toward computer literacy for all, there is no plan or deadline. The Ministry of Education, therefore, should consider its own plan for computer conferences, gatherings, etc. inside schools to keep all teachers in touch with computers and their development.

Perhaps one important issue in initial preparation is that it should be "voluntary". Voluntary attendance has been found to be more successful (Stetcher, 1984). The INSET course therefore should consider ways which could increase the number of volunteers among the participants. Of course, place, time and type of course are important in this issue.

## 12.4 INSET Course Design for Science Teachers:

Previous work on in-service teacher education courses has dealt either with non-computer-based INSET (for example Pirie, 1989; Ingvarson & MacKenize, 1988; Sparks, 1983) or more specifically with INSET in the area of Information Technology (for example, Stetcher, 1984; Lewis, 1983, Gardner & Megarity, 1987). Neither of these perspectives is directly related to the work of teacher education in subject-based computer applications (Sutherland, et al. 1991a).

The work of Rosamund Sutherland and her colleagues, the Microworlds Course (MWC 1986-1987) in the UK, and the Johns Hopkins University and the Baltimore City Public School System, Computers to Enhance Science Education (CESE 1986-1988) in the USA, provide appropriate models to be used for Saudi Arabian science teacher training for the following reasons:

- Both courses were implemented and succeeded: 80% and 90% of trained teachers in the MWC and CESE respectively reported using computers after their training.
- The two courses are concerned with the use of generic computer applications, which is what the current approach is looking for.
- At 30 and 12 days for MWC and CESE respectively, the training courses are not too long. It is likely that the Saudi Arabian Ministry of Education would accept a similar period.
- The courses developed confidence in the use of the computer as a problem solving tool.
- The courses were developed to be used with secondary level teachers (CESE was developed for high, middle and elementary school teachers).
- Finally, and perhaps most importantly, the courses were directed to teachers with little or no computer experience, which is very similar to the situation of the majority of Saudi Arabia's science teachers.

However, the MWC was directed to mathematics teachers, while the CESE included some programming. The projects therefore would not be applied in their original forms, but used as guides for planning appropriate training courses for Saudi Arabian science teachers. The nature of the subjects suggest little would be lost in changing from mathematics in the MWC to science in the current model.

### 12.4.1 MWC Model:

The main aim of the MWC[1] project was to develop, implement and evaluate a programme of in-service teacher education concerned with the use of generic computer applications within the secondary school mathematics curriculum.

The organizers (the three authors) ran two courses. The number of teachers attending the course was 13 in Year 1 (1986-1987), and 7 in Year 2 (1987-1988). Two of these (one in each year) were part of their local education authority's advisory team and the majority (13) of the remaining teachers were in positions of some responsibility within their mathematics departments (7 were heads of department, 6 were deputy heads or equivalent). In addition, 5 held the position of head of computing within their school. 16 of the 20 course participants had at least five years' teaching experience and the ages of the participants ranged from late twenties to early fifties. Acceptance on the course was conditional on access to at least one computer within the teacher's mathematics classroom. The course did not provide institutionalised qualifications for the teachers and in this respect they were all voluntarily motivated to attend the course.

The course was structured to be 30 days' attendance at the university over the period of one school year, with a mixture of blocks of time (up to one week) and one-day sessions at fortnightly intervals (see figure

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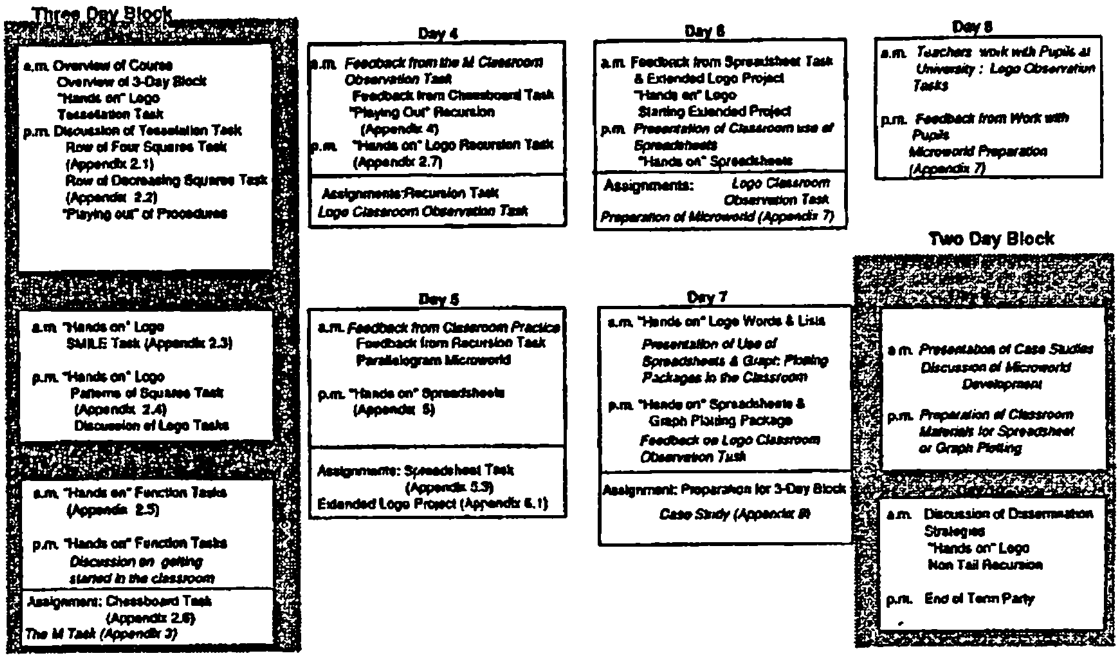
1. More information about the project can be found in the following sources: Sutherland, et al. 1990 and 1991 Volumes 1,2 and 3.

12.1). The blocks were to focus upon specific issues. In the sessions at schools, teachers were asked to try activities <u>in</u> <u>schools</u>, which allowed opportunities for the course organisers to work with the teachers in the classroom with pupils.




All tasks written in italics are concerned with classroom issues.

Figure continue....

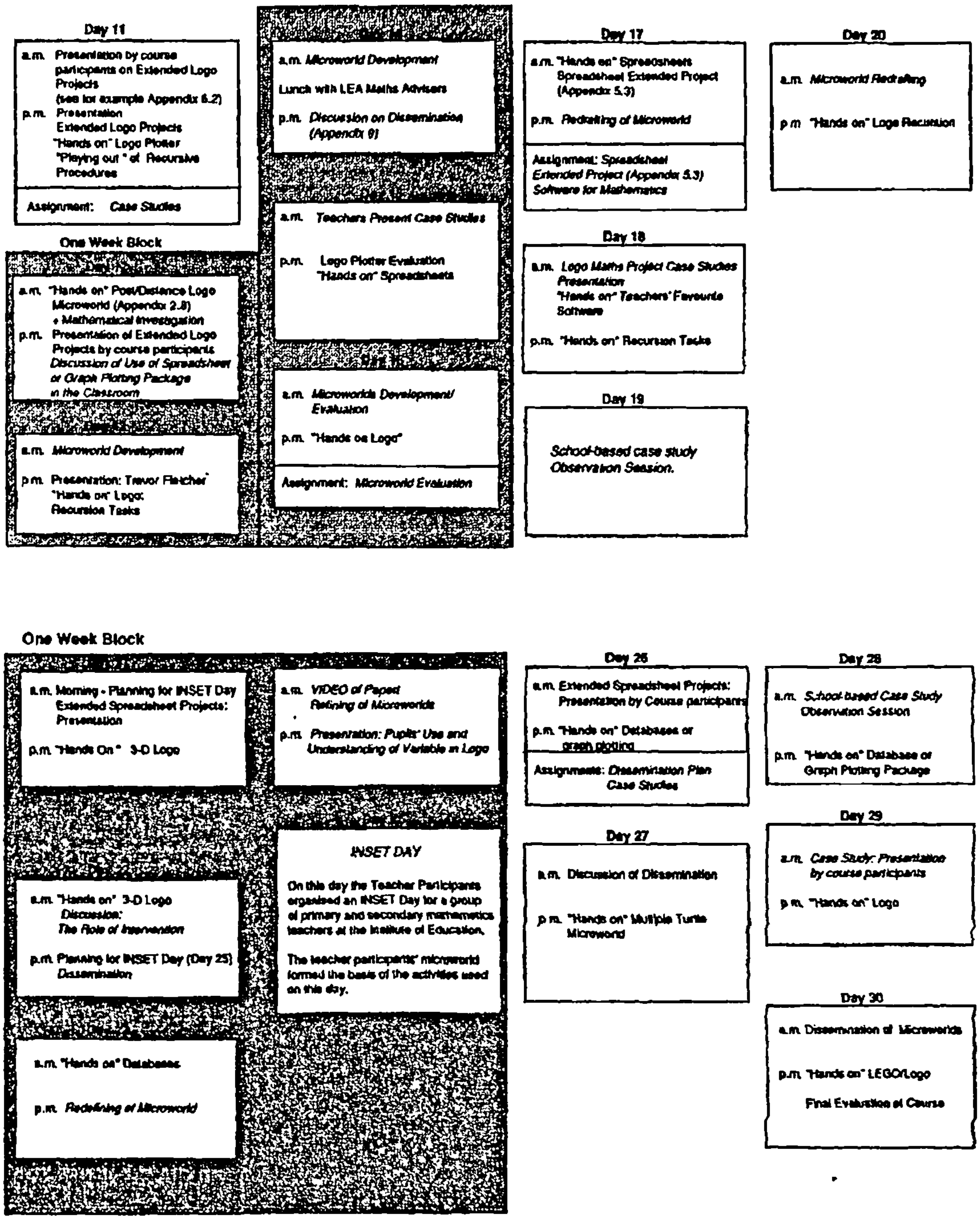



Figure 12.1 MWC model (source, Sutherland, et al. 1991a)

The course was divided into three parts. At the beginning of the course, a three-day block provided the participants with the opportunity to get to know each other and to become confident in using Logo[1]; in the middle term, the block was devoted to microworld[2] design and production of curricular materials; in the final term, the block focused on questions of dissemination and evaluation. The course was structured around the following activities:

- hands-on activity: during the course sessions participants worked on both open-ended exploratory projects and structured well-defined projects chosen with specific learning aims in mind.
- extended projects: course participants were asked to produce an extended computer-based project, reflecting their own learning and drawing on mathematical ideas;
- classroom-based work: after the first three days, the participants were asked to use computers within one of their classrooms;
- case studies: participants were required to complete case studies of two pupils using Logo in their mathematics lessons throughout the year;
- microworlds: to reflect teachers' experience of the ways in which pupils commonly hold alternative conceptions of mathematical ideas, the microworlds were evaluated by the teachers in their schools;

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1. An educational programming language

2. Microworlds involved work with the participants in designing computer-based microworlds for a specific area of the mathematics curriculum.

- dissemination: the course participants were expected to develop dissemination procedures within their schools' mathematics department and also within their own LEAs. Each teacher devised a plan related to the needs and situation within his or her school.

Although the course was successful, there were some deficiencies in the course in general, and the first run specifically, as follows:

a) Personal confidence and competence were the most frequently given reasons for continuing to use the computer in the teachers' classrooms. Therefore, in-depth training on a small range of software is more successful than building up a wide range of various types of software. The findings of the course showed that four teachers who were relatively unconfident about their own personal use of Logo at the end of the course had all been less motivated to engage in computer-based activities which aimed at personal use and confidence-building in the early stages of the course.

b) The need for the course organizer to be familiar with applications both from a personal and professional point of view is a critical factor in influencing which computer activities continue to be used in the classroom. During the first course, the course organizers had minimal expertise in the use of spreadsheets for themselves and within the mathematics classroom. This was no longer the case during the second year and the course tutors' ability to build in more pupil-focused activities in the spreadsheet work was reflected in an increase in the proportion of teachers from the second course who continued to use spreadsheets in the classroom.

In addition, most of the course was held at the university, while recent studies have claimed more success with school-based training, including classroom-based training (see for example, Goler, 1990; DES, 1989a and 1990).

### 12.4.2 CESE Model:

This course aimed[1] to help science teachers acquire the skills necessary to integrate effectively computer technology into science teaching. This purpose focused on instructional uses as much as on the personal and managerial benefits of computer use.

From 1986 to 1988, five training workshops were implemented with 100 teachers (40 high school, 40 middle school, and 20 elementary) who ranged in computer literacy from novice to experienced user. Each training workshop consistd of 12 days held bimonthly during one semester of the school year (Table 12.1). Each full-day session coupled instruction with supervised practice and was followed up with homework assignments and a brief review at the start of the next meeting day. Teachers were released from their regular classroom responsibilities, and money to hire substitutes was provided. Two teachers were selected from the same school to provide peer support during training and to act as first level of support in subsequent integration of acquired skills into classroom teaching. Between sessions, teachers wers asked to complete assignments, practice skills, and begin to incorporate those skills into classroom learning. An Appleworks

1. More information about the course can be found in Roseman & Brearton (1989)

application package was distributed to the participants. The package includes software for wordprocessor, database and spreadsheet. They also were given two sets of laboratory probeware. Each teacher was required to develop two detailed lesson plans that demonstrated effective computer use in science teaching, one employing database or spreadsheet and the other using an interface device. They presented these lessons first to their peers and then to a statewide audience at a final conference.

| Day | Content |
|---|---|
| 1 | Computer awareness/delivery, assembly, setup |
| 2 | Wordprocessor |
| 3 | Database |
| 4 | Spreadsheet |
| 5 | Integration of applications |
| 6 | Interface presentation/construction |
| 7 | Interface use |
| 8 | Programming |
| 9 | Trouble shooting/software evaluation |
| 10 | Design/presentation of projects |
| 11 | Project presentation and discussion |
| 12 | Conference |

Table 12.1 CESE model (source, Roseman & Brearton, 1989)

Over 200 lesson plans demonstrating computer use in science learning were developed. Each lesson plan consisted of lesson objectives, motivational activity, procedures, assessment and assignments. The project staff used a specifically developed questionnaire and direct observation to assess classroom use.

Although the project covered training issues related to personal benefit, it did not cover all teachers' professional needs, i.e pedagogical issues (see Table 12.1 above). This could explain why although 90% of trained teachers continued to use computers for their personal benefit, only 75% continued to use computers in their science classrooms.

### 12.4.3 Course Structure for Science Teachers:

The course designs described (i.e MWC and CESE) will be modified to be suitable for use with Saudi Arabian science teachers.

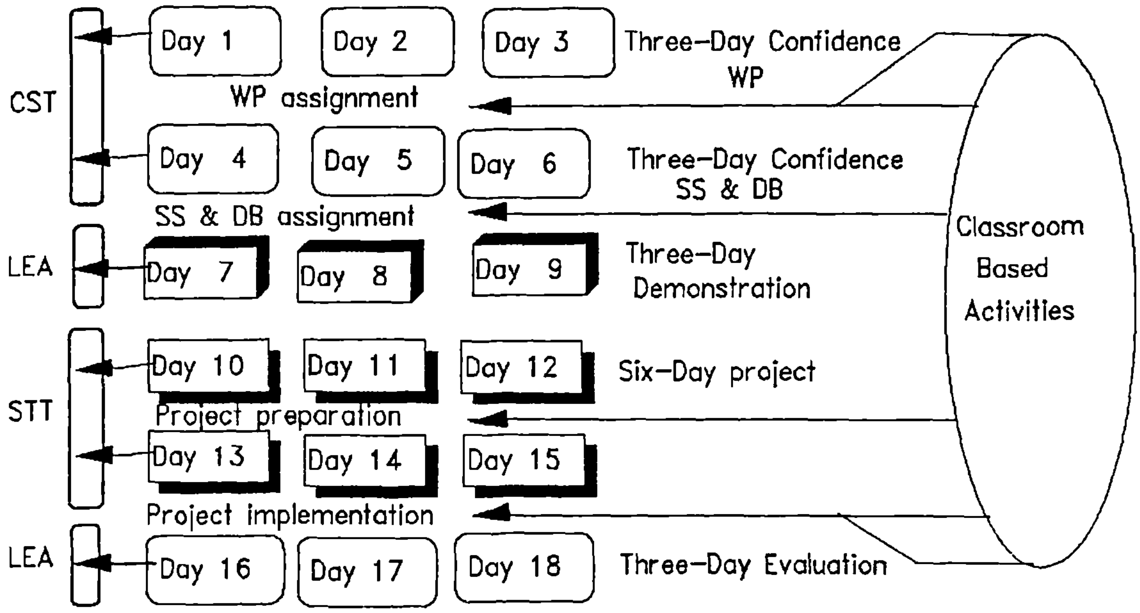
The proposed course is based on the positive findings of the MWC and CESE studies. Similar activities to those of MWC and CESE will be used, but the whole course will be relocated in local schools. This will decrease the cost of the course and would very likely increase the number of voluntary participants. As with MWC and CESE a number of class-based activities will be included in the course.

The teachers will be trained in the use of generic software. Programming will not be presented because, as Chapters 2,3 and 6 have shown, there is little relationship between programming and the use of computers to aid science teaching. Instead, wordprocessor use seems most appropriate in the earliest training stages, because it is easy to use and useful for personal benefit. Perhaps easier than Logo which was used in the MWC.

Sutherland, et al. spent 30 days running their course (i.e MWC). Half of their time was spent on Logo, and the remainder on computer applications. CESE took 12 days for each course, but it gave little training for professional purposes. Therefore, it is likely that 18 days would be an appropriate period for training in computer generic applications only, as planned for the current course. This will replace the period spent on Logo (15 days) in the case of MWC with 3 days of wordprocessor, and will add 6 extra days to the case of CESE for pedagogical issues.

The course is designed to be held bimonthly, similar to the practises of the MWC and CESE; therefore, 34-36 weeks are needed to complete the course. This period is deliberately equal to a whole study year according to the normal Saudi Arabian school system.

In addition to these 18 days, teachers will be asked to prepare classroom assignments between the block-sessions throughout the course (Figure 12.2). Both of MWC and CESE found improvement in personal and professional confidence after the teachers had classroom-based work.




* CST= computer studies teachers, LEA= Local Education Authority, STT= science teacher trainers, WP= wordprocessor, SS= spreadsheet, DB= database

Figure 12.2 Proposed INSET course design for science teachers

The first three days will provide the participants with the opportunity to get to know each other and become confident in using Windows and one type of Arabic wordprocessor: for example WordPerfect (an Arabic version) or Word for Windows (with Arabic support). The procedure could be along the lines of:

. the teachers will be given a brief overview of the course;

. hands-on Windows: using mouse, loading Windows, moving around, selecting applications, open and close Windows, moving from Latin to Arabic options etc.;

. hands-on wordprocessor: loading the program, creating a file, saving a file, loading a file, etc.;

. produce and print out a given document;

. produce and print out a personal document.

Teachers will be asked to produce an assignment using the word-processor concerning their own classroom business. Lesson plans are appropriate for this task. Participants should be encouraged to use wordprocessor facilities such as bold, underline, justification, etc.

The next three days will develop the skills introduced in the WP part of the course, but using a type of spreadsheet, an Arabic version of Excel, or Lotus 1,2,3 for example, and a type of database, for example Data Base System (an Arabic database). During these three days, the participants will engage in the following activities:

. hands-on spreadsheet & database: loading the program, creating a file, saving a file, loading a file, etc.;

. entering data, processing tables, adding data, making formulae, etc.;

. processing graphs, chosen graph types such as chart, pie, line, etc.;

. produce and print out given data;

. produce and print out personal data.

Homework assignment will include introducing personal data into the spreadsheet and database. For example, teachers could be asked to record their pupils' marks and chart them in order to produce the best and most useful assessment.

Both of the two "confidence" parts of the course should be given by computer studies teacher colleagues and their role should end at this stage.

The next three days will be run by the Local Education Authority and will be spent in demonstrating computer business applications. The teachers will have access to various types of generic software and some examples of their classroom use in science teaching.

In the following six day-block of the course, specialist science tutors will go to the schools and continue the programme by addressing issues relating to the use of computers in the science curriculum. During this period, the participants will be involved in developing and implementing a project in the area of the science curriculum. The teachers could continue to seek advice from their CST colleagues. The idea is to develop competence in the use of the computational environment, and enable participants to feel for themselves the power that the computer can give them to express scientific ideas independently. They will be encouraged to reflect on pupils' conceptions, build pedagogic sequences and evaluate the potential contribution of the computer in science subjects. They will also be encouraged to give more control in terms of scientific problem solving to the learner. Teachers should be encouraged to continue to extend the ideas seen on the course and include personal interests and needs.

The first three days of this block will be spent in describing pedagogical issues and illustrating some examples of developing and implementing generic software in science classrooms. Tutors could film themselves in one lesson and show it to the teachers. Some software examples from previous or other courses could also be presented. After this session, teachers will be asked to go to their schools and think about and choose a project for themselves from one science subject; writing its objectives, plan, content, science concept skills, problem skills, etc.

In the second three days, teachers will be expected to bring along different forms of project proposals. Most of this period will be spent in discussing these proposals and improving ways of implementing them in order to allow every teacher to try his project in his own science classroom. Tutors should visit every teacher and help him to implement the project successfully. Tutors will give the teachers follow-up work in the classrooms because the feedback from the course could give important evidence for its effectiveness. Brophy and Good (1974) found that providing teachers with feedback on their classroom practice is an important element engendering change in teacher-pupil interaction. MWC stressed the value of tutors visiting course-participants in their schools.

During the implementation of the project, teachers will be asked to develop case studies of two of their pupils working with the computer throughout the implementation of the project. This is to provide a focus for a discussion of teaching and learning.

The final three days of the course will mainly be held by LEAs and will be directed toward dissemination and evaluation of the course. The participants will be encouraged to consider ways of disseminating the course among their science teacher colleagues and other teachers in their schools.

The main target of the evaluation is to find out whether the participants are using computers in their daily lessons, and whether they use them successfully.

After a period of a year or so, more investigation of the participants should be made to assess the course. Three ways could be used for this evaluation:

a) Visits to the participants in their classrooms: every participant should be visit individually.

b) Questionnaire: a questionnaire survey will be distributed to the participants. Modified forms of the MWC and CESE questionnaires could be used. Because, the first questionnaire was made for English mathematic teachers while the second one was made for American science teachers, appropriate modification of the questionnaires will be needed in order to make them useful for Saudi Arabian science teachers.

c) Interviews with the participants: all of the participants should be interviewed to address their difficulties, problems, views, etc.

### 12.4.4 Strategies to Locate the INSET:

The proposed INSET programme will be organized to be used inside schools. This requires strategies to enable science teachers to achieve the aims of the programme properly. Five main sources will need to cooperate to run the proposed INSET programme. These are: the Ministry of Education; the Educational Development Directorate at the Ministry of Education; the LEAs; the schools; and the Universities.

The centralization of the Saudi Arabian educational system (see Chapter 1) necessitates that the Ministry of Education play an important role, especially in funding, course-content and official matters. To enable schools to engage in the training programme, permission from the Ministry would be needed. Alessi and Shih (1989) have argued about the advantages of the centralized state-funded educational system which enables the government to make nation-wide decisions and implement programmes for the schools, resulting in similar facilities and greater equity across schools. The Ministry of Education could have additional control over the course materials, content, and way of implementation if, for example, it funds the production of course materials.

The normal budget of the schools would also be insufficient. Because the Ministry is often in charge of the schools' equipment and provisions, it seems, therefore, that the main role of the Ministry of Education would be to permit and fund the programme.

The Educational Development Directorate will mainly be responsible for curriculum development. It should provide various computer tasks within the science curriculum through the science experiment book which is normally given to Saudi students, alongside a text book. The teacher's book should include the appropriate procedure and evaluation for every task.

The role of the Local Educational Authorities would as be intermediaries between the Ministry of Education and the schools. In this respect, LEAs could organize the allocation of resources (financial and other) to each school as required. The advisory unit at LEAs could be responsible for carrying out the second and final three day blocks of the programme and for those issues related to demonstrating the software and evaluating the course in post-course visits to the schools. Science advisors could participate with science trainers in presenting pedagogical issues.

Because the course is school-based, a great part of the responsibility for it will be located in schools, particularly among computer studies teachers. The first six days of the programme will be run by computer studies teachers. The programme requires computer studies teachers to act as co-ordinators for the training programme as a whole in the schools.

It is important also to consider the need for the support of both school heads and the rest of the staff throughout the training period and in the dissemination afterwards.

The important source of organizing the proposed programme is the universities. Planning, allocating and running the pedagogical training days will be carried out by science trainers at the universities throughout the country. The role of science trainers should be as advisors and organizers to the proposed programme as a whole. They should build up a model for learning upon which the INSET is based. The model would aim to create an environment in which the individual teachers would take responsibility for their own learning and would emphasise small-group work with the group being carefully formed to foster an atmosphere of collaboration, maximising the constructive spreading of ideas and minimising potentially destructive relative dominance within the groups. Science trainers would supply ideas from the course to the Educational Development Directorate in order to include them in the science curriculum. They would also develop course-materials related to science topics.

The trainers should show their role as facilitators who set up science activities, encourage reflection and extension, build-in ideas related to pedagogical practice, develop specific activities to highlight science ideas. They need to develop their own prior specialism and work alongside teachers to synthesise experiences.

## 12.5 Strategies for Pre-Service Training for Science Trainee:

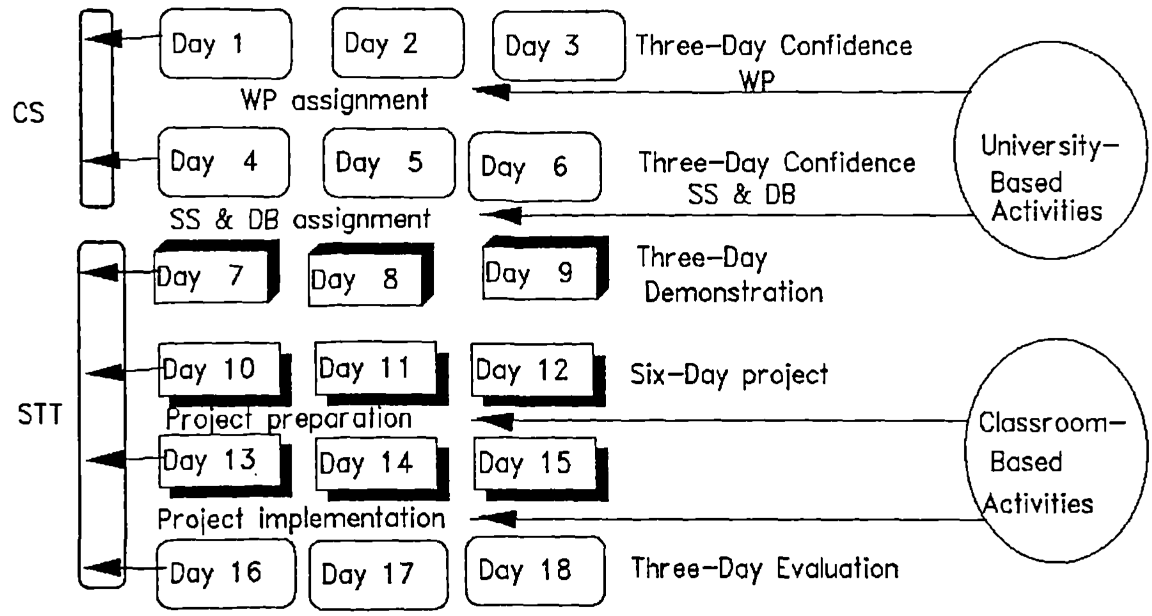
The importance of integrating computers in the science curriculum requires careful consideration of computer-based subject training within the initial science training. The training institutions throughout the country, then, have to determine the most appropriate ways to respond to these pressures.

The proposed strategies for initial teacher training are aimed at ensuring that all trainee science teachers acquire the appropriate knowledge and skills in information technology and competence in their professional application in the school. The same principle of the proposed INSET can be used to guide the development of courses within ITT to improve the preparation of trainee teachers with regard to the use of information technology in schools throughout the science curriculum.

Similar content to that of the proposed INSET could be considered for integration within initial teacher training. Appropriate integration of training activities could be considered during the teaching method work of the ITT programme for science trainees. The pre-service course will use some ideas, materials, etc. from the INSET programme.

The Saudi Arabian Universities usually include two training courses in the final year of science trainees' ITT, concerning science teaching methods. They normally use the first course for theoretical background of science teaching, while the second course is used for practical training in the schools. The IT training course, therefore, could be integrated within these two courses.

A modified version on the INSET model described earlier is proposed for use in pre-service training (Figure 12.3). The course is split into two parts. The first part, confidence-building part consisting of two three-day blocks, will be given by computer specialists at computer institutes of the Universities during the first ITT science teaching method course. The remaining parts of the course will be given by the science trainers during the training practice periods in the schools.




*** CS= computer specialists, STT= science teacher trainers, WP= wordprocessor, SS= spreadsheet, DB= database.**

Figure 12.3 Proposed pre-service course design for science teacher trainees

The role played by science trainers in the proposed in-service and pre-service programmes requires urgent training of science trainers to use computers both personally and professionally; otherwise, neither programme will be valid.

The computer specialists at the Universities could train their science trainer colleagues to have sufficient levels of confidence to use a computer for personal purposes; similar to the first two three-day blocks in the teachers' courses. Science trainers must realize the importance of computers for themselves and for their students as well. They should use computers in their daily business and seek for help from their computer science colleagues as necessary.

As the trainers become familiar with the computer and its generic applications, they could subsequently train themselves on pedagogical issues. They need to select some tasks for themselves to experiment with. Some research and articles in the field of computers in science classrooms would be very helpful. Of course, there may be no Arabic examples, but the majority of Saudi Arabian trainers can read and understand English, where various examples are available.

Finally, the training of science teachers, trainees and trainers, should not be considered as the final step, but as the open-door to the long process of developing the best use of computers in the science curriculum. There should be links between research and proposals about development, training and appropriate curriculum, teachers and regular INSET programmes and the development of computer hardware and use of software in science teaching. The potential benefit from computer teacher training requires more attention from both Universities and the Educational Development Directorate in the Ministry of Education in order to make the best gains from computers in science education for both teachers and pupils. Basic research activities could start with replication/extension of USA and UK studies to establish validity of ideas in SA context. This research would also provide teaching materials and very important classroom confidence and classroom experience for tutors.

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**SITING AN ALUMINIUM PLANT.** Longman Micro Software, UK.

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**The Universal Word** (1989). Wysiwyg Corporation.

# APPENDICES

# Appendix A: SYLLABUSES OF COMPUTER COURSES

## I Introduction to Computers:

* Introduction to computers and their uses;
* Computer contents;
* Computer unites;
* Microcomputers and their uses;
* Introduction to programming;
* Data processing.

## II Introduction to Programming (BASIC):

* Program coding in BASIC;
* Computer instructions;
* BASIC commandos: structure and use;
* BASIC capability.

## III Computer Programming and Introduction to Information Systems:

* Arrays;
* Strings;
* Sub-programs;
* Functions;
* Files;
* Introduction to microcomputers;
* Computer operating system;
* Introduction to information systems;
* Databases.

## Appendix B: THE 47 MODERN CAL STUDIES IN SCIENCE TEACHING


1. Adams, D. & Shrum, J. (1990). The effects of microcomputer-based laboratory exercises on the acquisition of line graph construction and interpretation skills by high school Biology students. Journal of Research in Science Teaching, 27, 8, 777-787.

2. Barlow, S. (1990). An investigation of the effects of microcomputexts upon problem-solving skills in college Biology students. Dissertation Abstract International. No.: AAC9113566.

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# Appendix C: INTERVIEW SCHEDULES

# I INTERVIEW SCHEDULE WITH SCIENCE TEACHERS

Name(if you like)..........School..... City of the school ...

Qualifications:

1) What is your teaching subject?(Eg Physics, Chemistry...)
...............

2) What is your qualification? (Eg MEd, MSc, BSE, BSc..)
...............

3) For how long have you been teaching?...........

4) For how long have you been a science teacher?......

5) Have you got a personal computer?.....
If, yes, for what do you use it?
if, not, are you thinking of buying one?

6) Are there any computers in your school?
If yes, how many? .........., Have you ever used these computers?
...............

7) If you reply No to 5 and 6, have you had any computer experience?....
if yes, give more information?....

## Characteristics:

### Knowledge:

1- Do you know how the computer is turned on and off?.......

2- Could you tell me what is a hard disk and what is a floppy disk?.....

3- Do you know what is BASIC language?.....
If yes, give brief description?......

4- Can you give tell me what are the ways in which computers can be used in schools? ...................

5- What is the best way to use them as far as you know?
..............

6- Do you think science teaching is one of these ways?.........
If yes, how? If no, why not? ....................

7) Could you tell me how far the computer can aid the science teacher in his teaching? .....

a. audio-visual presentation,
b. an alternative to the science laboratory,
c. science games.

8) Could you tell me what is computer assisted learning? ......

**Training:**

1) Have you been on any courses in computers? If yes, give some details (When? Where? What was it about? How many days did it last?)....

2- Has any institute, private company, etc. held any courses related to use computer in teaching?...
If yes, who organised them? When were these courses held? What form did they take? (Eg workshops, visiting speakers, formal discussion, demonstrations,.....), did you attend this\these course\s?....
If yes, what was your aim?....

**Attitudes:**

**Attitudes Toward Computer Assisted Learning:**

1) Do you think it is enough to teach the pupils about computers? (Knowledge about computers, computers technique, social applications of computers),
If no, what other learning do they need?..........

2) Do you feel you need computers to help you in your teaching? ......

3) Do you expect any discipline problems to arise as a result of introducing computer in science teaching? .....
If yes, give examples:
Economic problems?
Training problems?
Software problems?
Curriculum problems?

4) What is your view of teaching science with the assistance of computers?
........................
What advantages are there? What disadvantages?

5) What is your view on introducing CAL into secondary school science teaching?
.....................
- Do you think it would change the teachers' role?
  * increase lesson period, .....
  * make teachers' job more difficult.....
- Do you think it would change the teaching?
  * make it more difficult, .......
  * make it more interesting........
- Do you think it would influence the curriculum?
  * make it more difficult,......
  * make them more complicated......
- Do you think science teachers will be trained in using CAL.
..............

6) Do you agree that the use of CAL in science teaching can achieve results which might otherwise be thought impossible? .....

7) Have you read educational computing articles to look for teaching ideas? .........

8) Have you followed the recent developments in using computers for teaching? .........

9) What are you thoughts about the future development of computer uses in science teaching? ..................

10) Would you ever contemplate using a computer in your teaching?
If yes, in what circumstances? if no, why not?
......................................

<u>Attudes to Computers in Education:</u>

10 Do you read any research, reports about computers in education?
If so, how many?(eg weekly, monthly, ....) ...........; and how do you get them? ................................

2) What do you think about them? (Eg would you like to see more, easier, cheaper) ..................

3) Do you think science teachers need to learn how to use computers? .... ,Why?
What kind of learning do you think they need?
..................................

4) Could you outline some advantages of computer use in education?
.......................

5) Are there any disadvantages?
...................................

6) What are your views on the use of computers in education generally?
......................

7) Do you think we do not need to introduce computers to our secondary schools because they cost too much money? ...............

8) Do you think secondary school students should be taught some computer courses? .......... Why? .............

9) Do you think the use of computers in schools increases pupils' interest?
...

10) Have you encouraged your pupils to arrange a personal visit(s) to a computer installation? (Institution, private company,......)
If yes, what were the aims of this(these) visit(s)?
....................

11) Have you used film or video in your teaching to show applications of computers? .........

12) Do you agree or disagree that computers can encourage the pupils':
* flexibility
* openness of mind
* grasp of technological change
* problem solving skill
* help handicaps

13) Do you meet with computer teachers to discuss computers in education? If yes, what are your discussions usually about?
* teaching ideas?
* computer techniques?
* the job in general?

<u>Attitudes</u> <u>toward</u> <u>Computers</u> <u>in</u> <u>General:</u>

1) Have you encountered computers? If yes,
When? .......
What was your first impression? .......................
Have your views changed? .............................
How do you feel about computers now? .................

2) Do you think it is the teacher's duty to introduce pupils to computers? ...... Why? .......

3) What are your views on the role of computers in society in general? ..........

4) Have you discussed media programmes and news about computers in the classroom? If yes, why? ......................

5) Have you talked about any computer application in your class?
If yes, what was the subject? ............

6) Have you ever seen TV or video- programmes about computers? ....
If, yes, what do you think about them?.....

7) Have you read computing or technical magazines? ...
If yes, what is your opinion of them ?
Are you interested in them?
Do you want to see more?
Are they too specialised?

8) Have you made any personal visit(s) to a computer installation? (Eg institute, private company,....)
If yes, what was the aim of this visit?..........

9) Do you keep in touch with any private computer company? ....
If so, why? ........................................
*******************************************************

Any comments or suggestions? ....................................................

## II INTERVIEW SCHEDULE WITH COMPUTER STUDIES TEACHERS

Name(if you like)..........School..... City of the school ...

Qualifications:

1) For how long have you been teaching? ......

2) What is your qualification? (Eg MEd, MSc, BSE, BSc..) .....

3) What is your main teaching subject?.......

4) Do you have any experience of teaching computer studies out of school? If so, give some details (e.g When? Where? For how long?) ....................

### Training:

1) Have you had any inservice training?
If yes, give a description (How long was the course? What was it about? ....................

2) Have you been on any courses about using computers in education? If yes, give some details (When? Where? What was it about? How many days did it last?) ...........

3) Has any institute, private company, etc. held any courses related to the use of computers in education?
If yes, who organised them? When were these courses held? How many teachers have attended these courses? What form did they take? (e.g workshops, visiting speakers, formal discussion, demonstrations) ..................................................

4) Do you think you need more training about computers in education? ...........

### Relationship With Science Teacher:

1) Do you meet with the science teachers to discuss computers in education?
If yes, how often (daily, weekly...) ....
What sort of questions do they ask you? ...............

2) Have you tried to hold any courses on computers for the teachers in the school?
If so, what were your aims? ........

### Factual Information:

1) Is there a computer room in your school?
If so, what are its contents? ..........

2) Are there any computers in your school?
If yes, how many?.........,What type of machines? .......... What type of software do you have?..........
If no, has there been any promise from the officials to supply them? ......

3) How many computer courses are taught in your school? ....
Give some details of contents .........

4) How many computer teachers are there in your school? .......

5) Are there any computer books in the school library? ....
Is there any lack of these? ............

6- Are any official reports sent to you?
If yes, how many per year? ................
What is your opinions about them? (e.g would you like to see more, easier, ,....... ) ...................

7) What percentage of your pupils have PCs? (Approximately) .......

8) Can you outline some advantages of computer use in secondary schools?
...........................................

9) Are there any disadvantages?................

10) Could you outline the problems you find during your work?
* lack of machines,
* lack of software,
* difficulties with the officials.
* difficulties with the headmaster.
* difficulties with pupils' attitudes to computers.

11) Do you expect any discipline problems to arise as a result of introducing computers into science teaching? ......
* control problems,
* training problems,
* software problems.

*********************************************************

Any mor comments or suggestions.

## III INTERVIEW SCHEDULE WITH SCIENCE TEACHER TRAINERS

Name(if you like).......... Institute.....

**Quilifications:**

1) What is your subject?........

2) What is your qualification? (Eg PhD, MEd..) ........

3) For how long have you been trainer?...........

4) What courses you teach? ............

5) Do you personally have any experience of using computers? ...

6) Have you done any research about computers in education? ...

7) Has your department any policy for CAL? ......

8) Any comments about trainer qualification in computer education?
* do you think trainers should be trained to use computers? ...

**Knowledge about CAL:**

1) Could you list some ways we can use computers in science teaching?
.......................

2) In what way can the computer assist science learning? ..........................

3) Do you think it is possible to use computers as an alternative to the science laboratory?
If yes, how? .................

4) Do you think it is possible to teach problem-solving skills by computer?
If yes, how? ....................

5) Could you give me examples of CAL?
Tutorial?
Simulation?
Games?

**Attitudes to CAL:**

1) Are there any computers in your institute? .......
If, yes, Do you use them in your teaching?
If yes, in what way(s) have you used them?
.............................

2) What should pupils learn about computers?.... Why?
* computer science?
* CAL?
* wordprocessors?
* nothing?

3) Do you think it is the trainer's duty to train teachers how to use computers in their teaching? ......
Why? ................

3) What are your views on the role of computers in science teaching?
................

4) Do you think science teachers need to learn how to use computers? .....,Why? ........,What kind of training do you think they need? ......

5) What do you think is the role of computers in science treaching?....

6) Have you discussed researche, media programmes and news about computers in science teaching with your students? ..................

7) Do you ask your students to read some CAL books or reports? ..............

8) Have you trained your students in how they can use CAL in their teaching? ......
* have you given them some lectures?
* have you given them some practical sessions?
* have you given them some applications?

9) Have you read any researche, reports or articles about CAL in science teaching? .........., If yes
* did you find them interesting?
* useful?
* difficult?

10) Have you followed the recent development of using CAL in science teaching? .........

11) Could you outline some advantages of CAL in science teaching? .........................

12) Are there any disadvantages?
.............................

13) Do you agree or disagree that computers can encourage the pupils':
* flexibility
* openness of mind
* grasp of technological change
* problem solving skill
* overcoming handicaps

14) What is your view on introducing CAL into secondary school science teaching? .................

15) Do you think that including training on CAL for science trainees could change the preservice programme?
* make it more interesting,
* make it more difficult?,
* make it more modern?

16) Do you expect any discipline problems to arise as a result of introducing computer to science teaching? .....
If yes, give examples:
* software problems?
* official problems?
* training problems?

**************************************************************

Any comments or suggestions.........................

Appendix D:

TO WHOM IT MAY CONCERN

I have checked and revised the Arabic translation of three types of questionnaires done by Mr. Ibrahim Al-Mohaissin as part of his research work. I have compared the Arabic translation to the original version in English and found that they are near to identical.

The ideas are put in simple straightforward language. I am quite sure that the final versions that I have seen do not contain ambiguous expressions, nor do they cause confusion or misunderstanding of ideas to any native Arabic speaker.

( Dr. A. Alharbi )
Assistant Professor,
Department of Foreign Languages.

4th.4.1992



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الرقم : / /

التاريخ : / / ١٤هـ

## Appendix E: QUESTIONNAIRES

## I : SCIENCE TEACHERS' QUESTIONNAIRE

Dear Science Teacher,

This questionnaire is part of a study investigating the possibility of introducing computers into science teaching in Saudi Arabia Secondary Education.

In view of the important role that science teachers play, we need to know about their ideas and views relating to this matter. The conclusion of the survey recommend improvements and the use of computers in science teaching in our schools.

All information you give will be held by me personally in confidence, and it will not be shown to any other person. You are free to write your name or not, as you wish.

For the purpose of this survey there are no wrong or right answers. Your personal honest opinion is the only required response. Please put down what you really feel and complete all of the questionnaire so you can give it to me when I come to collect it from you on /  /1992.

Thank you in advance..

The researcher

Ibrahim Al-Mohaissin,

College of education,

Department of Curriculum and Instruction

Madinah, POBox 344, 25040 (personal).

***PART ONE:***

Please tick the appropriate column to indicate your personal view of the following items.

* Remember there is no wrong or right response.

| No | Items | SA | A | DA | SDA |
|---|---|---|---|---|---|
| 1 | Computers are as important to science pupils as text books in the classroom. | | | | |
| 2 | Introducing computers into science teaching would decrease the teacher's role. | | | | |
| 3 | A computer training programme should be compulsory for every science teacher. | | | | |
| 4 | Computers will increase the amount of teacher-student interaction in the science classroom. | | | | |
| 5 | I look forward to a time when computers are more widely used in science teaching. | | | | |
| 6 | Science teachers manage without computers, so computers are not really necessary. | | | | |
| 7 | It is better to train science teachers in the schools rather than Universities. | | | | |
| 8 | Computers will improve science pupils' problem-solving skills. | | | | |
| 9 | Teaching science with the aid of computers would only make difficult topics easier. | | | | |
| 10 | Computers bring more disadvantages than advantages to science teaching. | | | | |

| No | Items | SA | A | DA | SDA |
|---|---|---|---|---|---|
| 11 | Science teachers must know a great deal about how computers work if they want to use them in science teaching. | | | | |
| 12 | Using computers in the science classroom will not improve pupils' positive attitudes towards the sciences. | | | | |
| 13 | Teaching science with the aid of computers would make teaching easier for the most able pupils only. | | | | |
| 14 | I would like my computer studies colleague to train me to use a computer in my teaching. | | | | |
| 15 | Computers will improve science pupils' abilities. | | | | |
| 16 | There is no benefit from the use of computers in science teaching commensurate with their cost. | | | | |
| 17 | If the schools use more computers, they will need fewer teachers. | | | | |
| 18 | A computer studies teacher needs to know how to use computers in science teaching before he trains science teachers. | | | | |
| 19 | Computers will increase the amount of anxiety pupils experience in the science classroom. | | | | |
| 20 | The use of computers in science teaching would require large changes in science teaching methods. | | | | |

| No | Items | SA | A | DA | SDA |
| --- | --- | --- | --- | --- | --- |
| 21 | Only the computer studies teacher should use computers regularly in his teaching. | | | | |
| 22 | Teaching science with the aid of computers would make teaching easier for all of the pupils. | | | | |
| 23 | Using computers in science classrooms could weaken the teacher's control of the students. | | | | |
| 24 | A teacher of computer studies is not the best person to train science teachers to use computers. | | | | |
| 25 | Science teaching is better without the use of computers. | | | | |
| 26 | I would be willing for an expert from outside school to train me to use computers. | | | | |
| 27 | I almost never think about using a computer in my teaching. | | | | |
| 28 | Teaching science with the aid of computers would make teaching easier. | | | | |
| 29 | Computers can enhance the learning of pupils in every science subject. | | | | |
| 30 | Computers will improve science pupils' thinking. | | | | |

***PART TWO:***

Please respond to the following items by ticking one of the two columns: True, False or in column DN, if you do not know or you have no idea about the correct answer.

| No | Item | T | F | DN |
|---|---|---|---|---|
| 1 | Computers can be used as a private tutor. | | | |
| 2 | Computers are used to introduce large amounts of information to pupils. | | | |
| 3 | Computers have little application to science teaching. | | | |
| 4 | To use a computer successfully, one needs to learn how to program. | | | |
| 5 | One of the computers' weaknesses is that it is difficult to change the text when you type by computer. | | | |
| 6 | The use of the PC is unrelated to the needs of the schools. | | | |
| 7 | The Saudi Arabian market has various examples of English software, but almost nothing in the Arabic language. | | | |
| 8 | Existing commercial software can be used in science teaching. | | | |

*PAET THREE:*

Please tick the appropriate column to indicate the frequency of your classroom activities in the following items.

* Note that 1/D= almost every day, 1/W, once a week, 1/M, once a month, 1/T, once a term or more, and N nearly never.

| No | Items | 1/D | 1/W | 1/M | 1/T | N |
|---|---|---|---|---|---|---|
| 1 | I allow my students to do experiments by themselves. | | | | | |
| 2 | I use video in my teaching. | | | | | |
| 3 | I use an overhead projector in my class. | | | | | |
| 4 | I make personal visits to computer centres. | | | | | |
| 5 | I include discussion of TV science programmes in my teaching. | | | | | |
| 6 | I read educational computing articles to look for teaching ideas. | | | | | |
| 7 | I meet with computer teachers to discuss computer uses in teaching. | | | | | |
| 8 | I advise my students to follow developments in technology. | | | | | |

*PART FOUR:*

Please respond to the following questions:

1- What is your educational job?

[] Science teacher      [] Science advisor

2- What is your teaching subject?

[] Physics [] Chemistry

[] Biology [] Geology

[] Others (specify please) ...

3- What is your qualification?

[] MEd [] MSc [] BSE [] BSc

[] Others (specify please) ...

4- For how long have you been teaching?... Year(s).

5- Have you got a personal computer? If yes, for what do you use it? ...

6- Do you personally have any experience of using computers? If so,
what kind of experience you have?...

7- Have you been on any courses in computers? If yes, give some details
When? ... Where? ... Who ran it?... How many days was it? ... What was it about? ...

8- Have you been on any courses related to the use of computers in teaching? If yes, Who ran it? ... When were these courses held? ... How many teachers attended them (approximately)? ...

Any comments or suggestions ................

* Would you kindly make sure that you have responded to all items

Thank you for your kind help

Yours

I Al-Mohaissin

Madinah, P.O.Box 25040

Name (optional) ..........., School ......

**بسم الله الرحمن الرحيم**

أخي/ معلم العلوم

السلام عليكم ورحمة الله وبركاته وبعد

هذه الاستبانة جزء من دراسة تحاول البحث عن مدى إمكانية إدخال الكمبيوتر في تدريس العلوم للمرحلة الثانوية في المملكة العربية السعودية.

ونظراً لأهمية دور معلمي العلوم، فنحن في حاجة لمعرفة وجهات نظرهم حول هذا الموضوع. ونتائج هذا البحث سوف تستخدم فقط كاقتراح لتطوير تدريس العلوم واستخدام الكمبيوتر في مدارسنا.

جميع البيانات التي تعطيها سأحتفظ بها شخصياً بسرية ولن يطلع عليها أي شخص آخر. وإذا أردت عدم ذكر إسمك فيمكنك ذلك.

ليس هناك إجابة خاطئة أو صحيحة، فالإجابة التي تشعر بها حقيقة هي الإجابة المفيدة. لذلك، من فضلك أكتب فقط الإجابة التي تمثل رأيك الخاص.

الرجاء الإجابة على جميع فقرات الاستبانة. وسوف أحضر لأستلمها منك إن شاء الله في يوم / /١٤١٢هـ شاكراً لكم حسن تعاونكم سلفاً.

أخوكم

مبتعث جامعة الملك عبد العزيز

بالمملكة المتحدة

إبراهيم بن عبد الله المحيسن

المدينة المنورة/ فرع جامعة الملك عبد العزيز/ كلية التربية

ص.ب ٣٤٤، ٢٥٠٤٠ (شخصي).

القسم الأول:

من فضلك ضع علامة (✓) في الخانة الملائمة لرأيك في العبارات التالية:

* تذكر بأنه لا توجد إجابة صحيحة أو خاطئة

| الرقم | العبارة | أوافق تماما | أوافق | لا أوافق | أوافق |
|---|---|---|---|---|---|
| ١- | تعتبر أهمية الكمبيوتر لحصة العلوم اليوم كأهمية الكتاب المدرسي.......................... | | | | |
| ٢- | قد يقلل إدخال الكمبيوتر في تدريس العلوم من دور المعلم ...... | | | | |
| ٣- | ينبغي أن يكون التدريب على الكمبيوتر إلزامياً لجميع معلمي العلوم ............................ | | | | |
| ٤- | سيزيد استخدام الكمبيوتر في حصة العلوم من التفاعل بين التلميذ والمعلم ............................ | | | | |
| ٥- | إني أتطلع إلى الوقت الذي يستخدم فيه الكمبيوتر على نطاق أوسع في تدريس العلوم............................ | | | | |
| ٦- | باستطاعة معلمي العلوم إتقان عملهم بدون الكمبيوتر، لذلك فإن الحاجة ليست ماسة إليه ............................ | | | | |
| ٧- | تدريب معلمي العلوم على استخدام الكمبيوتر داخل المدارس أفضل من تدريبهم في الجامعات ............................ | | | | |
| ٨- | سيساعد الكمبيوتر على تحسين مهارة القدرة على حل المشكلات لدى التلاميذ عند استخدامه في تدريس العلوم ............ | | | | |
| ٩- | تدريس العلوم بمساعدة الكمبيوتر قد يسهل تدريس المواضيع الصعبة فقط ............................ | | | | |
| ١٠- | سلبيات استخدام الكمبيوتر في تدريس العلوم أكثر من إيجابياته. . . | | | | |
| ١١- | على معلم العلوم أن يعرف الكثير عن تشغيل الكمبيوتر إذا أراد أن يستخدمه في تدريس العلوم ............................ | | | | |
| ١٢- | لن يطور استخدام الكمبيوتر في حصة العلوم من اتجاهات التلاميذ الموجبة نحو العلوم ............................ | | | | |
| ١٣- | قد لا يستفيد من استخدام الكمبيوتر في حصة العلوم إلا التلاميذ المتفوقين فقط ............................ | | | | |

| الرقم | العبارة | أوافق تماماً | أوافق | لا أوافق | لا أوافق أبداً |
| --- | --- | --- | --- | --- | --- |
| ١٤- | أحب أن أتدرب على الكمبيوتر بواسطة زميلي معلم الكمبيوتر ... | | | | |
| ١٥- | سيزيد الكمبيوتر من ذكاء التلاميذ عند استخدامه في تدريس العلوم ... | | | | |
| ١٦- | فوائد استخدام الكمبيوتر في تدريس العلوم لا تكافىء تكاليفه .. | | | | |
| ١٧- | إذا ازداد استخدام المدارس للكمبيوتر، فإن حاجتها للمعلمين سوف تقل ... | | | | |
| ١٨- | ينبغي على معلم الكمبيوتر الإلمام بكيفية استخدام الكمبيوتر في تدريس العلوم قبل أن يدرب معلم العلوم... | | | | |
| ١٩- | سيزيد استخدام الكمبيوتر في تدريس العلوم من حالات القلق لدى التلاميذ ... | | | | |
| ٢٠- | قد يستدعي استخدام الكمبيوتر في حصة العلوم تغيراً جذرياً في طرق تدريس العلوم ... | | | | |
| ٢١- | معلم الكمبيوتر وحده دون غيره يجب أن يستخدم الكمبيوتر في تدريسه باستمرار ... | | | | |
| ٢٢- | تدريس العلوم بمساعدة الكمبيوتر سيسهل تدريس جميع التلاميذ ... | | | | |
| ٢٣- | قد يقلل استخدام الكمبيوتر في حصة العلوم من ضبط المعلم للتلاميذ ... | | | | |
| ٢٤- | معلم الكمبيوتر ليس أفضل شخص يمكن أن يدرب معلمو العلوم على استخدام الكمبيوتر ... | | | | |
| ٢٥- | من الأفضل تدريس العلوم بدون استخدام الكمبيوتر... | | | | |
| ٢٦- | لن أمانع من التدريب على الكمبيوتر بواسطة متخصصين من خارج المدرسة ... | | | | |
| ٢٧- | نادراً ما أفكر في استخدام الكمبيوتر في تدريس العلوم ... | | | | |
| ٢٨- | ستكون عملية تدريس العلوم أسهل عند استخدام الكمبيوتر ... | | | | |
| ٢٩- | يستطيع الكمبيوتر مساعدة التلاميذ على التعلم في جميع مواد العلوم ... | | | | |
| ٣٠- | سيساهم استخدام الكمبيوتر في تدريس العلوم في تحسين تفكير التلاميذ ... | | | | |

القسم الثاني:

أجب عن العبارات التالية بوضع علامة (√ ) في أحد الخانتين: صحيح، غير صحيح أو في الخانة: لا أدري - إذا كنت لا تعلم الإجابة أو ليس لديك خلفية عن السؤال.

| الرقم العبارة | صحيح | غير صحيح | لا أ |
|---|---|---|---|
| ١- يمكن استخدام الكمبيوتر كمدرس خصوصي ............ | | | |
| ٢- يستخدم الكمبيوتر لتقديم أكبر قدر من المعلومات للتلميذ...... | | | |
| ٣- تطبيقات الكمبيوتر في تدريس العلوم محدودة ............ | | | |
| ٤- لتستخدم الكمبيوتر بنجاح، تحتاج أن تعرف كيف تبرمج ........ | | | |
| ٥- من عيوب الكمبيوتر صعوبة التغيير في النص المطبوع بواسطته .... | | | |
| ٦- يختلف الكمبيوتر الشخصي تماماً عما يجب أن يستخدم في المدارس .............................. | | | |
| ٧- يوجد في الأسواق السعودية الكثير من برامج الكمبيوتر الانجليزية، لكن يندر وجود أخرى عربية .............. | | | |
| ٨- يمكن استخدام برامج الكمبيوتر التجارية (الموجودة بالأسواق) في تدريس العلوم............................... | | | |

القسم الثالث:

من فضلك ضع علامة ( √ ) في الخانة التي تمثل عدد مرات العمل في العبارات التالية:

※ لاحظ أن: ك/ي= كل يوم تقريباً ١/س= مرة في كل أسبوع

١/ش = مرة في كل شهر ١/ف= مرة في كل فصل دراسي أو أكثر

ب= تقريباً لم يحدث أبداً

| الرقم العبارة | ك /ى | ١ /س | ١ /ش | ١ /ف | ب |
|---|---|---|---|---|---|
| ١- أسمح لتلاميذي بعمل تجارب بأنفسهم......... | | | | | |
| ٢- أستخدم الفديو في تدريسي ............... | | | | | |
| ٣- أستخدم جهاز العاكس الرأسي في الفصل ...... | | | | | |

| الرقم | العبارة | ك /ى | ١ /س | ١ /ش | ١ /ف | ب |
|---|---|---|---|---|---|---|
| ٤- | أقوم بزيارات لمراكز الكمبيوتر. . . . . . . . . . . . . . . . . . . . | | | | | |
| ٥- | أتطرق في تدريسي لمناقشة البرامج العلمية التي تعرض في التلفزيون | | | | | |
| ٦- | أقرأ مقالات عن الكمبيوتر لأبحث عن أفكار تدريسية . . . . . . . . . | | | | | |
| ٧- | عندما أقابل معلم الكمبيوتر أناقش معه استخدام الكمبيوتر في التدريس . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . | | | | | |
| ٨- | أحث تلاميذي بمتابعة أخبار التكنولوجيا . . . . . . . . . . . . | | | | | |

**القسم الرابع:**

من فضلك أجب عن جميع الأسئلة التالية:

١- ما عملك؟

[ ] مدرس علوم. [ ] موجه علوم.

٢- ماذا تدرِّس؟

[ ] فيزياء. [ ] كيمياء [ ] أحياء. [ ] جيلوجياء.

[ ] أخرى (حدد)....

٣- ما مؤهلاتك؟

[ ] ماجستير في التربية. [ ] ماجستير في العلوم. [ ] بكالوريوس في العلوم والتربية. [ ] بكالوريوس في العلوم. [ ]

أخرى (حدد).....

٤- كم عدد سنوات الخبرة؟ .........

٥- هل لديك كمبيوتر شخصي؟ [ ] نعم، [ ] لا. إذا كانت الإجابة نعم، لأي شيء تستخدمه؟..............

٦- هل لديك خبرات أخرى في استخدام الكمبيوتر؟ [ ] نعم، [ ] لا. إذا كانت الإجابة نعم، مانوع الخبرة التي لديك؟............

٧- هل حضرت أية دورة في الكمبيوتر؟ [ ] نعم، [ ] لا. إذا كانت الإجابة نعم، أعط بعض البيانات:

متى؟ أين؟ من نظمها؟ كم كانت مدتها؟ عن ماذا كانت؟

٨- هل حضرت أية دورة لها علاقة باستخدام الكمبيوتر في التدريس؟

[ ] نعم، [ ] لا. إذا كانت الإجابة نعم:

من نظمها؟ أين أقيمت؟ كم عدد المدرسين الذين حضروها بالتقريب؟..........

*************************************

*******

أخي المعلم، استغل بقية هذه الصفحة لكتابة أي اقتراحات تتعلق باستخدام الكمبيوتر في تدريس العلوم، وسوف تؤخذ هذه الاقتراحات بعين الاعتبار عند كتابة هذه الأطروحة إن شاء الله تعالى.

- هلا تأكدت سريعاً من أنك أجبت على جميع فقرات الاستبانة.
- جزاك الله خيراً على منحي هذا الجزء من وقتك.

أخوك/ إبراهيم المحيسن

المدينة المنورة

ص.ب ٣٤٤، ٢٥٠٤٠

الإسم [إذا أحببت]/.... المدرسة/

## II : COMPUTER STUDIES TEACHERS' QUESTIONNAIRE

Dear Computer Studies Teacher,

This questionnaire is part of a study investigating the possibility of introducing computers into science teaching in Saudi Arabia Secondary Education.

In view of the important role that computer studies teacher play, we need to know about their ideas and views relating to this matter. The conclusion of the survey recommends improvements and computerization of science teaching in our schools.

All information you give will be held by me personally, in confidence, and it will not be shown to any other person. You are free to write your name or not as you wish.

For the purpose of this survey there are no wrong or right answers. Your personal honest opinion is the only required response. Please put down what you really feel and complete all of the questionnaire so you can give it to me when I come to collect it from you on /  /1992.

Thank you in advance..

The researcher

Ibrahim Al-Mohaissin,

College of Education,

Department of Curriculum and Instruction

Madinah, POBox 344, 25040 (personal).

***PART ONE:***

Please tick the appropriate colum to indicate your personal view of the following items.

* Remember there is no right or wrong response.

| No | Items | SA | A | DA | SDA |
|---|---|---|---|---|---|
| 1 | Teaching science with the aid of computers will make science teaching easier. | | | | |
| 2 | There are not enough computers in the schools to be used for science teachers' training. | | | | |
| 3 | The only person who should control school computers is the computer studies teacher. | | | | |
| 4 | The use of computers in science teaching should be made compulsory immediately. | | | | |
| 5 | The computer studies teacher should meet with his science colleague(s) to discuss teaching ideas. | | | | |
| 6 | If I am to train my science colleagues in my school, then I need at least a year to do so. | | | | |
| 7 | If computers were introduced into science teaching, then problems would arise as a result. | | | | |
| 8 | It will be easy for me to train science teachers to use databases. | | | | |
| 9 | I would like my science colleagues to tell me about science teaching methods. | | | | |

| No | Items | SA | A | DA | SDA |
|---|---|---|---|---|---|
| 10 | It is possible for science teachers to be trained to use computers by their computer studies colleagues. | | | | |
| 11 | Science teaching is better without the use of computers. | | | | |
| 12 | I think computer studies teachers are teaching well, so there is no need to train them how to teach. | | | | |
| 13 | Science teachers are not capable of being trained to use computers. | | | | |
| 14 | A computer studies teacher does not need to be trained in teaching if he has enough knowledge of his subject. | | | | |
| 15 | I don't think that science teachers would like me to train them to use computers. | | | | |
| 16 | The computer studies teacher is the only person who should use computers in his teaching. | | | | |
| 17 | Even if science teachers are trained to use computers, they will not be able to introduce pupils to computer applications. | | | | |
| 18 | Computers will decrease the amount of teacher-pupil interaction in the classroom. | | | | |
| 19 | The only subject which should use computers is computer studies. | | | | |
| 20 | I would be willing to train my science teacher colleague to use a computer in his teaching. | | | | |

| No | Items | SA | A | DA | SDA |
|---|---|---|---|---|---|
| 21 | Students do not like any person to train them to use computers except the computer studies teacher. | | | | |
| 22 | I think it is enough for pupils to study computer studies courses. | | | | |
| 23 | I would be willing to allow my science teaching colleagues to use the computers. | | | | |
| 24 | There is no need to train a computer studies teacher to teach because he can get the experience in the classroom. | | | | |
| 25 | It would be easy for me to train science teachers to use spreadsheets. | | | | |

***PART TWO:***

Please respond to the following 5 questions:

1- What subject did you study?

[] Computer science

[] Computer and education

[] Computer engineering

[] Others (specify please) ...

2- What is your qualification?

[] MEd [] MSc [] BSE [] BE

[] BSc [] Others (mention please) ...

3- Do you have an Education Diploma? [] Yes [] No

4- For how long have you been teaching?... Year(s).

5- Have you trained in the use of:

a) Databases [] Yes [] No b) Spreadsheets [] Yes [] No

c) Wordprocessors [] Yes [] No e) Computer networks [] Yes [] No

6- Do you have a personal computer? If yes,
for what do you use it? ...

7- Have you been to any courses in teaching? If yes, give some details
When? ... Where? ... Who ran them? ... For how many days did the course last? ... What was it about? ...

8- Have you been to any courses related to the use of computers in teaching?
If yes, who ran them? ... When were these courses held? ... How many teachers attended them (approximately)? ...
**********************************************************

Any comments or suggestions ................

* Would you kindly make sure that you have responded to all items

Thank you for your kind help

Yours

I Al-Mohaissin

Madinah, P.O.Box 25040

Name (optional) ..........., School ......

**بسم الله الرحمن الرحيم**

أخي/ معلم الكمبيوتر

السلام عليكم ورحمة الله وبركاته وبعد

هذه الاستبانة جزء من دراسة تحاول البحث عن مدى إمكانية إدخال الكمبيوتر في تدريس العلوم للمرحلة الثانوية في المملكة العربية السعودية.

ونظراً لأهمية دور معلمي الكمبيوتر، فنحن في حاجة لمعرفة وجهات نظرهم حول هذا الموضوع. ونتائج هذا البحث سوف تستخدم فقط كاقتراح لتطوير تدريس العلوم واستخدام الكمبيوتر في مدارسنا.

جميع البيانات التي تعطيها سأحتفظ بها شخصياً بسرية ولن يطلع عليها أي شخص آخر. وإذا أردت عدم ذكر اسمك فيمكنك ذلك.

ليس هناك إجابة خاطئة أو صحيحة، فالإجابة التي تشعر بها حقيقة هي الإجابة المفيدة. لذلك، من فضلك أكتب فقط الإجابة التي تمثل رأيك الخاص.

الرجاء الإجابة على جميع فقرات الاستبانة. وسوف أحضر لأستلمها منك إن شاء الله في يوم / /١٤١٢هـ شاكراً لكم حسن تعاونكم سلفاً.

أخوكم

مبتعث جامعة الملك عبد العزيز

بالمملكة المتحدة

إبراهيم بن عبد الله المحيسن

المدينة المنورة/ فرع جامعة الملك عبد العزيز/ كلية التربية

ص.ب ٣٤٤، ٢٥٠٤٠ (شخصي)

**القسم الأول:**

من فضلك ضع علامة (✓) في الخانة الملائمة لرأيك في العبارات التالية:

❊ تذكّر بأنه لا توجد إجابة صحيحة أو خاطئة.

| الرقم | العبارة | أوافق تماما | أوافق | لا أُوافق | لا أُوافق أب |
|---|---|---|---|---|---|
| ١ | سيكون تدريس العلوم أسهل عند استخدام الكمبيوتر | | | | |
| ٢ | لا يوجد في المدرسة أجهزة كافية لتدريب معلم العلوم عليها. | | | | |
| ٣ | لا يحق لغير معلم الكمبيوتر أن يتدخل في الكمبيوتر المدرسي. | | | | |
| ٤ | يجب أن يقرر استخدام الكمبيوتر في تدريس العلوم فوراً | | | | |
| ٥ | لابد أن يلتقي معلم الكمبيوتر مع زملائه معلمي العلوم لمناقشة أفكار تدريسية | | | | |
| ٦ | أحتاج إلى سنة كاملة على الأقل لأتمكن من تدريب معلمي العلوم في المدرسة على استخدام الكمبيوتر | | | | |
| ٧ | قد تظهر بعض المشاكل إذا استخدم الكمبيوتر في تدريس العلوم | | | | |
| ٨ | لن أجد صعوبة في تدريب معلمي العلوم على استخدام قواعد المعلومات | | | | |
| ٩ | أرغب أن يزودني معلم العلوم بمعلومات عن طرق التدريس. | | | | |
| ١٠ | من الممكن تدريب معلم العلوم على استخدام الكمبيوتر بواسطة زميله معلم الكمبيوتر. | | | | |
| ١١ | من الأفضل تدريس العلوم بدون استخدام الكمبيوتر | | | | |
| ١٢ | يقوم معلموا الكمبيوتر بأداء تدريسهم بشكل جيد، لذلك لا أرى حاجة لتدريبهم على التدريس | | | | |
| ١٣ | معلم العلوم غير قابل للتدرّب على استخدام الكمبيوتر. | | | | |
| ١٤ | لا يحتاج معلم الكمبيوتر أن يتدرب على التدريس، إذا كان يملك معلومات كافية في تخصصه | | | | |
| ١٥ | لا أعتقد أن معلم العلوم يرغب في أن أدربه على الكمبيوتر. | | | | |
| ١٦ | يحق لمعلم الكمبيوتر وحده دون سواه استخدام الكمبيوتر في تدريسه | | | | |

| الرقم | العبارة | أوافق تماما | أوافق | لا أوافق | أو |
|---|---|---|---|---|---|
| ١٧- | حتى ولو تدرب معلم العلوم على استخدام الكمبيوتر، فلن يستطيع تعريف التلاميذ بتطبيقات الكمبيوتر .......... | | | | |
| ١٨- | سوف يقلل استخدام الكمبيوتر في حصة العلوم من التفاعل بين التلميذ ومعلم العلوم .......................... | | | | |
| ١٩- | المادة الوحيدة التي يجب استخدام الكمبيوتر فيها هي مادة الكمبيوتر .............................. | | | | |
| ٢٠- | إني على استعداد لتدريب زميلي معلم العلوم على كيفية استخدام الكمبيوتر في تدريسه .................... | | | | |
| ٢١- | التلاميذ لا يريدون أحداً غير معلم الكمبيوتر ليدربهم على الكمبيوتر. .......................... | | | | |
| ٢٢- | أعتقد أنه يكفي تدريس التلاميذ مواد عن الكمبيوتر ........ | | | | |
| ٢٣- | لن يكون لدي مانع من استخدام زملائي معلمي العلوم لأجهزة الكمبيوتر .......................... | | | | |
| ٢٤- | لا حاجة من تدريب معلم الكمبيوتر على كيفية القيام بالتدريس لأنه سيكتسب هذه الخبرة مع مرور الوقت ............ | | | | |
| ٢٥- | لن أجد صعوبة في تدريب معلم العلوم على استخدام الصفحات المجدولة (الجداول الالكترونية، مثل لوتس١، ٢، ٣) ....... | | | | |

**القسم الثاني**

من فضلك أجب عن جميع الأسئلة التالية:

١- ما هو تخصصك الدراسي؟

أ- علوم كمبيوتر. ب- هندسة كمبيوتر. ج- كمبيوتر وتربية.
د- أخرى (حدد)...

٢- ما هي مؤهلاتك؟

أ- ماجستير في التربية. ب- ماجستير في العلوم. ج- بكالوريوس في العلوم والتربية. د- بكالوريوس في العلوم. هـ بكالوريوس في الهندسة. و- أخرى (حدد)...

٣- هل تحمل دبلوم في التربية؟ [ ] نعم. [ ] لا.

٤- منذ كم سنة وأنت تدرس؟ ...........سنة.

٥- هل تدربت على استخدام:
أ- قواعد المعلومات؟ [ ]نعم، [ ]لا .
ب- الصفحات المجدولة؟ [ ]نعم، [ ]لا .
ج- منسق الكلمات؟ [ ]نعم، [ ]لا .
د- شبكات الكمبيوتر؟ [ ]نعم، [ ]لا .
٦- هل لديك كمبيوتر شخصي؟ [ ] نعم، [ ]لا . إذا كانت الإجابة نعم، لأي شيء تستخدمه؟
٧- هل حضرت أية دورة في التدريس [ ]نعم، [ ]لا، إذا كانت الإجابة بنعم، اعط بعض البيانات
متى؟ أين؟ من نظمها؟ كم كانت مدتها؟ عن ماذا كانت؟
٨- هل حضرت أية دورة لها علاقة باستخدام الكمبيوتر في التدريس؟
[ ]نعم، [ ]لا . إذا الإجابة نعم:
من نظمها؟ أين أقيمت؟ كم عدد المدرسين الذين حضروا بالتقريب؟

❊ ❊ ❊

أخي المعلم، استغل بقية هذه الصفحة لكتابة أي اقتراحات تتعلق باستخدام الكمبيوتر في المدارس وفي تدريس العلوم، وسوف تؤخذ هذه الاقتراحات في عين الاعتبار عند كتابة هذه الأطروحة إن شاء الله تعالى.

❊ هلا تأكدت سريعاً من أنك أجبت على جميع فقرات الاستبانة.

❊ جزاك الله خيراً على منحي هذا الجزء من وقتك.

أخوك/ إبراهيم المحيسن
المدينة المنورة/ ص. ب ٣٤٤، ٢٥٠٤٠
الاسم [إذا أحببت]/.....
المدرسة/.....

## III : SCIENCE TEACHER TRAINERS' QUESTIONNAIRE

Dear Science Trainer,

This questionnaire is part of a study investigating the possibility of introducing computers into science teaching in Saudi Arabia Secondary Education.

In view of the important role that science trainers play, we need to know about their ideas and views relating to this matter. The conclusion of the survey recommends improvements and the use of computers in science teaching in our schools.

All information you give will be held by me personally, in confidence, and it will not be shown to any other person. You are free to write your name or not, as you wish.

As you know, there are no wrong or right answers. Your personal honest opinion is the only required response. Please put down what you really feel and complete all of the questionnaire so you can give it to me when I come to collect it from you on /  /1992.

Thank you in advance..


The researcher

Ibrahim Al-Mohaissin,

College of Education,

Department of Curriculum and Instruction

Madinah, POBox 344, 25040 (personal).

***PAET ONE:***

Please tick the appropriate column to indicate your personal view of the following items.

* Remember there is no right or wrong response.

| No | Items | SA | A | DA | SDA |
|---|---|---|---|---|---|
| 1 | Computers are as important to science students as text books in the classroom. | | | | |
| 2 | If I had the facilities, I would train my students to use computers. | | | | |
| 3 | A computer training programme should be compulsory for every science teacher trainer. | | | | |
| 4 | Computers will decrease the amount of teacher-pupil interaction in the science classroom. | | | | |
| 5 | I look forward to a time when computers are more widely used in science teaching. | | | | |
| 6 | A science teacher trainer has no time to be trained to use computers. | | | | |
| 7 | Computers will improve science pupils' problem-solving skills. | | | | |
| 8 | Computers bring more disadvantages than advantages to science teaching. | | | | |
| 9 | Science teachers must know a great deal about computers if they want to use them in science teaching. | | | | |

| No | Items | SA | A | DA | SDA |
|---|---|---|---|---|---|
| 10 | Using computers in the science classroom will not improve students' positive attitudes towards the sciences. | | | | |
| 11 | Science teacher trainers could be trained to use a computer by the schools' computer studies teacher. | | | | |
| 12 | Computers will improve science pupils' abilities. | | | | |
| 13 | There is no benefit from the use of computers in science teaching commensurate with their cost. | | | | |
| 14 | Even if a science teacher knows how to use a computer for personal home use, he will still require to be taught how to use it in the science classroom. | | | | |
| 15 | Science trainers should be aware of developments of using computers in science teaching. | | | | |
| 16 | Computers will increase the amount of anxiety students experience in the science classroom. | | | | |
| 17 | The use of computers would require large changes in teaching methods in science. | | | | |
| 18 | Science teachers should have INSET in the use of computers in their teaching. | | | | |
| 19 | I would like the school computer studies teacher to train me to use a computer in my teaching. | | | | |

| No | Items | SA | A | DA | SDA |
|---|---|---|---|---|---|
| 20 | Science teaching is better without the use of computers. | | | | |
| 21 | Science teachers' training programmes should include training in the use of computers in science teaching. | | | | |
| 22 | I will benefit from training in the use of computers in my own teaching. | | | | |
| 23 | Computers can enhance the learning of pupils in every science subject. | | | | |
| 24 | Computers will improve science students' thinking. | | | | |

***PART TWO:***

Please respond to the following items by ticking one of the two columns: True, False or in the column DN, if you do not know or you have no idea about the correct answer.

| No | Item | T | F | DN |
|---|---|---|---|---|
| 1 | Computers can be used as a private tutor. | | | |
| 2 | Computers are used to introduce large amounts of information to pupils. | | | |
| 3 | Computers have little applications to science teaching. | | | |
| 4 | To use a computer successfully, one needs to learn how to program. | | | |
| 5 | One of the computers' weaknesses is that it is difficult to change the text when you type by computer. | | | |
| 6 | The use of the PC is unrelated to the needs of the schools. | | | |
| 7 | The Saudi Arabian market has various examples of English software, but almost nothing in the Arabic language. | | | |
| 8 | Existing commercial software can be used in science teaching. | | | |

***PART THREE:***

Please respond to the following questions:

1- Name (optional) ..........., College ......

2- What is your subject? ...

3- What is your academic position?

4- For how long have you been a trainer?... Year(s).

5- Have read research or articles about:

a) use of databases in teaching? [] Yes [] No

b) use of spreadsheets in teaching? [] Yes [] No

c) use of wordprocessors in teaching? [] Yes [] No

6- Have you got a personal computer? If yes,
For what do you use it? ...

7- Do you personally have any experience of using computers?
If so,
what kind of experience do you have?...

8- Have you been to any courses related to the use of computers in teaching?
If yes, who ran them? ... Where were these courses held? ... How many trainers attended them (approximately)? ...

9- Have you written any article or conducted research about computers? If yes, was it theoretical or experimental? What was the title?

Any comments or suggestions .............

Thank you for your kind help

Yours

I Al-Mohaissin

Madinah, P.O.Box 25040

**بسم الله الرحمن الرحيم**

أخي/ مشرف معلم العلوم

السلام عليكم ورحمة الله وبركاته وبعد

هذه الاستبانة جزء من دراسة تحاول البحث عن مدى إمكانية إدخال الكمبيوتر في تدريس العلوم للمرحلة الثانوية في المملكة العربية السعودية.

ونظراً لأهمية دور مشرفي معلم العلوم، فنحن في حاجة لمعرفة وجهات نظرهم حول هذا الموضوع. ونتائج هذا البحث سوف تستخدم فقط كاقتراح لتطوير تدريس العلوم واستخدام الكمبيوتر في مدارسنا .

جميع البيانات التي تعطيها سأحتفظ بها شخصياً بسرية ولن يطلع عليها أي شخص آخر. وإذا أردت عدم ذكر إسمك فيمكنك ذلك. أما إذا أردت نتائج هذه الدراسة فارفق عنوانك.

كما تعلم ليس هناك إجابة خاطئة أو صحيحة، فالإجابة التي تشعر بها حقيقة هي الإجابة المفيدة. لذلك، من فضلك أكتب فقط الإجابة التي تمثل رأيك الخاص.

الرجاء الإجابة على جميع فقرات الاستبانة. وسوف أحضر لأستلمها منك إن شاء الله في يوم / /١٤١٢هـ شاكراً لكم حسن تعاونكم سلفاً .

أخوكم

مبتعث جامعة الملك عبد العزيز

بالمملكة المتحدة

إبراهيم بن عبد الله المحيسن

المدينة المنورة/ فرع جامعة الملك عبد العزيز/ كلية التربية

ص.ب ٣٤٤، ٢٥٠٤٠ (شخصي).

القسم الأول:

من فضلك ضع علامة (√ ) في الخانة الملائمة لرأيك في العبارات التالية:

* تذكر بأنه لا توجد إجابة صحيحة أو خاطئة

| الرقم | العبارة | أوافق تماماً | أوافق | لا أوافق | أ |
|---|---|---|---|---|---|
| ١- | تعتبر أهمية الكمبيوتر لحصة العلوم اليوم كأهمية الكتاب المدرسي .................................... | | | | |
| ٢- | لو هيأت لي الأجهزة والاستعدادات لدرّبت طلابي على استخدام الكمبيوتر في تدريسهم .......................... | | | | |
| ٣- | ينبغي أن يكون التدرّب على استخدام الكمبيوتر إلزامياً لجميع مشرفي معلم العلوم ........................... | | | | |
| ٤- | يزيد استخدام الكمبيوتر في حصة العلوم من فرص التفاعل بين التلميذ والمعلم ................................ | | | | |
| ٥- | إني أتطلّع إلى الوقت الذي يستخدم فيه الكمبيوتر على نطاق أوسع في تدريس العلوم ......................... | | | | |
| ٦- | ليس لدى مشرف معلم العلوم وقت للتدرّب على استخدام الكمبيوتر | | | | |
| ٧- | يساعد الكمبيوتر على تحسين مهارة القدرة على حل المشكلات لدى التلاميذ عند استخدامه في تدريس العلوم............. | | | | |
| ٨- | سلبيات استخدام الكمبيوتر في تدريس العلوم أكثر من إيجابياته.. | | | | |
| ٩- | على معلم العلوم أن يعرف الكثير عن تشغيل الكمبيوتر إذا أراد أن يستخدمه في تدريس العلوم ...................... | | | | |
| ١٠- | لا يساهم استخدام الكمبيوتر في حصة العلوم في تحسين اتجاهات التلاميذ الموجبة نحو العلوم .................. | | | | |
| ١١- | يمكن لمعلمي الكمبيوتر في المدارس أن يقوموا بتدريب مشرفي معلم العلوم على استخدام الكمبيوتر ................ | | | | |
| ١٢- | سيزيد الكمبيوتر من ذكاء التلاميذ عند استخدامه في تدريس العلوم .................................. | | | | |
| ١٣- | فوائد استخدام الكمبيوتر في تدريس العلوم لا تكافىء تكاليفه .. | | | | |

| الرقم العبارة | أوافق تماما | أوافق | لا أوافق | أ... |
|---|---|---|---|---|
| ١٤- حتى لو استطاع معلم العلوم استخدام الكمبيوتر لأغراض شخصية فإنه لا يزال يحتاج إلى التدرّب على استخدامه في تدريس العلوم. . . | | | | |
| ١٥- يجب أن يطلّع مشرف معلوم العلوم على تطور استخدام الكمبيوتر في تدريس العلوم . . . . . . . . . . . . . . . . | | | | |
| ١٦- سيزيد استخدام الكمبيوتر في تدريس العلوم من حالات القلق لدى التلاميذ . . . . . . . . . . . . . . . . . . | | | | |
| ١٧- قد يستدعي استخدام الكمبيوتر في حصة العلوم تغيراً جذرياً في طرق تدريس العلوم . . . . . . . . . . . . . . . . . . . | | | | |
| ١٨- يجب تدريب معلمي العلوم الذين على رأس العمل على استخدام الكمبيوتر في تدريسهم . . . . . . . . . . . . . | | | | |
| ١٩- أفضل التدرّب على استخدام الكمبيوتر بمعاونة معلمي الكمبيوتر المدرسي . . . . . . . . . . . . . . . . . . . . . | | | | |
| ٢٠- من الأفضل تدريس العلوم بدون استخدام الكمبيوتر . . . . . . . . . | | | | |
| ٢١- يجب أن يتضمن إعداد معلمي العلوم التدرّب على استخدام الكمبيوتر في تدريس العلوم . . . . . . . . . . . . . . . . . . | | | | |
| ٢٢- أعتقد أن التدرّب على استخدام الكمبيوتر سيفيدني في تدريسي . . | | | | |
| ٢٣- يستطيع الكمبيوتر مساعدة التلاميذ على التعلم في جميع مواد العلوم . . . . . . . . . . . . . . . . . . . . . . . . . . . | | | | |
| ٢٤- سيكون تفكير التلاميذ أفضل عند استخدام الكمبيوتر في تدريس العلوم . . . . . . . . . . . . . . . . . . . . . . . . | | | | |

**القسم الثاني:**

أجب عن العبارات التالية بوضع علامة (✓ ) في أحد الخانتين: صحيح، غير صحيح أو في الخانة: لا أدري - إذا كنت لا تعلم الإجابة أو ليس لديك خلفية عن السؤال.

| الرقم العبارة | صحيح | غير صحيح | لا أ |
|---|---|---|---|
| ١- يمكن استخدام الكمبيوتر كمدرس خصوصي ............ | | | |
| ٢- يستخدم الكمبيوتر لتقديم أكبر قدر من المعلومات للتلميذ ....... | | | |
| ٣- تطبيقات الكمبيوتر في تدريس العلوم محدودة ............ | | | |
| ٤- لتستخدم الكمبيوتر بنجاح، تحتاج أن تعرف كيف تبرمج ........ | | | |
| ٥- من عيوب الكمبيوتر صعوبة التغيير في النص المطبوع بواسطته ... | | | |
| ٦- يختلف الكمبيوتر الشخصي تماماً عما يجب أن يستخدم في المدارس ........................... | | | |
| ٧- يوجد في الأسواق السعودية الكثير من برامج الكمبيوتر الانجليزية، لكن يندر وجود أخرى عربية ............... | | | |
| ٨- يمكن استخدام برامج الكمبيوتر التجارية (الموجودة بالأسواق) في تدريس العلوم. ........................... | | | |

**القسم الثالث:**

من فضلك أجب عن جميع الأسئلة التالية:

١- الاسم (اختياري): الكلية:

٢- التخصص:

٣- الدرجة العلمية:

٤- عدد سنوات الخبرة:

| ٥- هل قرأت أبحاث أو موضوعات حول: | **نعم** | **لا** |
|---|---|---|
| أ- استخدام قواعد المعلومات في تدريس العلوم؟ | (   ) | (   ) |
| ب- استخدام الصفحات المجدولة (الجداول الالكترونية) في تدريس العلوم؟ | (   ) | (   ) |
| ج- استخدام منسق الكلمات في التدريس؟ | (   ) | (   ) |

٦- هل لديك كمبيوتر شخصي؟

إذا كانت الإجابة بنعم، لأي شيء تستخدمه؟...............

٧- هل لديك خبرات أخرى في استخدام الكمبيوتر؟

إذا كانت الإجابة بنعم، مانوع الخبرة التي لديك؟.............

٨- هل حضرت أية دورة لها علاقة باستخدام الكمبيوتر في التدريس؟
إذا كانت الإجابة بنعم:
من نظمها؟ أين أقيمت؟
كم عدد المشرفين الذين حضروها بالتقريب؟........
٩- هل عملت أي بحث له علاقة بالكمبيوتر؟
إذا كانت الإجابة بنعم، هل كان نظرياً أم علمياً؟ ما عنوانه؟

*******************************************

أخي المشرف، استغل بقية هذه الصفحة لكتابة أي اقتراحات تتعلق باستخدام الكمبيوتر في تدريس العلوم، وسوف تؤخذ هذه الاقتراحات بعين الاعتبار عند كتابة هذه الأطروحة إن شاء الله تعالى.

- هلا تأكدت سريعاً من أنك أجبت على جميع فقرات الاستبانة.
- جزاك الله خيراً على منحي هذا الجزء من وقتك.

أخوك/ إبراهيم المحيسن
المدينة المنورة
ص.ب ٣٤٤، ٢٥٠٤٠

## Appendix F: FACTOR ANALYSIS

| Corresponding scale | Item | FACTOR 1 | FACTOR 2 | FACTOR 3 | FACTOR 4 |
|---|---|---|---|---|---|
| EFFECTIVE | 1 | **.54683** * | -.21130 | .24762 | .16539 |
| BENEFIT | 2 | **.29730** | .28887 | .26270 | -.12736 |
| TRAINING | 3 | **.53597** | -.31344 | -.08947 | .08343 |
| VALUE | 4 | **.55910** | .03543 | -.01851 | .18477 |
| VALUE | 5 | **.68782** | -.13029 | -.08603 | .13007 |
| BENEFIT | 6 | **.57798** | .14178 | .08756 | .21782 |
| TRAINING | 7 | .11763 | -.04896 | **.62287** | .12534 |
| TRAINING | 8 | **.57516** | -.21186 | -.05927 | .16276 |
| BENEFIT | 9 | .06335 | **.44526** | -.16472 | -.04141 |
| VALUE | 10 | **.67953** | .22798 | -.00335 | -.07356 |
| TRAINING | 11 | -.22796 | .41692 | .04293 | **.55752** |
| TRAINING | 12 | **.56939** | .37046 | -.20664 | .01297 |
| BENEFIT | 13 | **.49623** | .40453 | -.11442 | .25034 |
| TRAINING | 14 | .13852 | -.20351 | **.68638** | .03607 |
| TRAINING | 15 | **.40950** | -.30009 | .18037 | -.16170 |
| VALUE | 16 | **.40459** | .30548 | -.26848 | -.09809 |
| BENEFIT | 17 | .28063 | **.44494** | .16260 | -.40031 |
| TRAINING | 18 | -.08045 | .43464 | -.19075 | **.48731** |
| TRAINING | 19 | **.44074** | .38908 | .02454 | -.27217 |
| VALUE | 20 | -.14517 | **.41013** | .07152 | -.02893 |
| TRAINING | 21 | .32039 | .19917 | .08532 | **-.42224** |
| BENEFIT | 22 | **.59251** | -.18872 | -.09080 | -.07421 |
| BENEFIT | 23 | .41374 | **.41390** | .06198 | -.21583 |
| TRAINING | 24 | -.10077 | .28059 | **.46635** | -.00522 |
| VALUE | 25 | **.72885** | .06977 | .09472 | .05761 |
| TRAINING | 26 | .31085 | -.29250 | **-.39573** | -.27551 |
| VALUE | 27 | **.50300** | .31276 | .09714 | .09727 |
| BENEFIT | 28 | **.68767** | -.33048 | -.04021 | .09535 |
| VALUE | 29 | **.67450** | -.23848 | -.01303 | .09020 |
| EFFECTIVE | 30 | **.62225** | -.29746 | -.03413 | .04554 |
| **Total Items** | 30 | 19 | 4 | 4 | 3 |

Factor pattern matrix for the 30 science teachers questionnaire items loading in the four factors:

* Bolding shows the highest item-loading

| Item | Complementary alpha | Item | Complementary alpha |
|---|---|---|---|
| 1 | .8736 | 15 | .8783 |
| 2 | .8817 | 16 | .8784 |
| 3 | .8747 | 19 | .8769 |
| 4 | .8729 | 22 | .8725 |
| 5 | .8692 | 25 | .8668 |
| 6 | .8718 | 27 | .8749 |
| 8 | .8733 | 28 | .8690 |
| 10 | .8684 | 29 | .8695 |
| 12 | .8725 | 30 | .8715 |
| 13 | .8745 | | |

alpha = 0.8791

Complementary alpha for 19 items of **IMPORTANT** factor of science teachers' questionnaire.

| Item | Complementary alpha |
|---|---|
| 9 | .3241 |
| 17 | .1590 |
| 20 | .4159 |
| 23 | .2868 |

alpha = .3691

Item-total correlation for 4 items of **PROBLEM** factor, complementary alpha for each item also shown

| Item | Complementary alpha |
|---|---|
| 7 | .0564 |
| 14 | -.1717 |
| 24 | .1666 |
| 26 | .4246 |

alpha = 0.2080

Item-total correlation for 4 items of **TRAINING1** factor, complementary alpha for each item also shown

| Item | Complementary alpha |
|---|---|
| 11 | -.3674 |
| 18 | -.0770 |
| 21 | .4961 |

Item-total correlation for 3 items of **TRAINING2** factor of science teachers' questionnaire, complementary alpha for each item also shown

alpha = 0.0627

**Appendix G: INTERVIEW WITH DR\ SAEED AL-MALLAIS VICE ASSISTANT MINISTER FOR EDUCATIONAL DEVELOPMENT ON 10th FEB 1992 11.00-11.45 am**

Introduction, aims of the interview, etc.

*Q1. The introduction of computers in SA secondary education was integrated with Developmental Secondary Schools (DSS) in 1985. So, what were your aims?.*

A1. In my opinion, education is always changing according to changing social variables. That means, schools should prepare pupils for what ever they are facing in their daily life, and this machine became an important tool in human life. So our duty was to train pupils on computers, this was the idea. The Ministry felt that it was important to introduce computer courses to develope computer literacy (both theory and practice), but not as a teaching aid.

*Q2. Why not as a teaching aid?.*

A2. First of all, we need to know more about this machine. We could use it later on to assist teaching, but we are still considering how and in which subject we can start.

*Q3. Are there any practical steps in that direction?.*

A3. Yes, we have a committee from the Ministry and some academic specialists in computers at Universities discusing this matter.

*Q4. What about Educationalists?.*

A4. We here, in the educational development directorate consult with the educationalists in all activities, whether in the Ministry, in the schools, or in the educational faculties at the Universities.

*Q5. Have you faced any difficulties during the introduction of computers, and if so, what were they?.*

A5. There were some difficulties:

1- First, there was a funding problem, because we were establishing a new subject. But today we have no fund problem. In fact we are invited to spend plenty of money on this subject.

2- The most serious problem was lack of teachers. When we introduced computers we had no computer teachers, so we invited teachers from outside the country to teach this subject. Most of them had little or no background in teaching methods.

3- Regarding text books, because we had no previous experience in teaching this subject, we sought help from specialists at the Universities. This led to some mistakes. These mistakes will be solved when we apply the new curriculum starting from next year.

*Q6. Would you kindly give us some details about the new curriculum?.*

A6. Next year we will stop teaching the current curriculum and replace it with the new curriculum. It will similar to that found in the developed countries. It will be start where the other stopped. It will highlight the machine itself and how it can be used.

*Q7. Ok. Back to the difficulties. Were there software problems?.*

A7. We are teaching computer studies, so we have no software problems. So far, if we use them to aid teaching, we might have problems; that is, we are expecting some difficulties in that field.

*Q8. What about training? I mean teachers' training, did you face difficulties?.*

A8. The main problem was the availability of computer teachers. As I said, we had no computer teachers at the time when we introduced computers to the schools. We also could not find enthusiastic teachers. But now this problem has been solved and we have no training problems. I also do not expect any training problems in the future. We have more than one source of training. Some educational colleges have already opened computer departments. We have made some contracts with computer institutes to include some teaching methods courses. These will prepare trainees to teach computer studies courses.

*Q9. What about those people who are already working with you in the field, like engineers teaching computers?.*

A9. Yes, we conducted some INST programmes in teaching methods. We also have a training plan for all computer studies teachers.

*Q10. Do you have a training policy for other subject teachers in secondary schools?.*

A10. We have not made any final policy yet. To be exact, the schools are ahead of us. Some of them are using computers in administration; plenty of teachers have trained themselves without any help from us. I do not think that we would have any problem if we wanted to train all of them. We have experience in such a job. For example, we trained more than 4000 primary school teachers in maths and science when we introduced math and science into primary education.

*Q11.Ok. I would like to turn now to the pupils. Have you considered the validity of the computer for the pupils and their attitudes towards it?.*

A11.Computers have become so important in social life. We are very pleased that we introduced them to our schools. We have to do that any way.

*Q12.That is fine. Can I ask about the future plans? I mean, you teach computers today as literacy courses. Will you continue to do so or will there be some change?.*

A12.We introduced computers as computer studies courses, but we might use them one day to assist teaching. We might teach all subjects through computers. As you know, some programs are available on the market. Some pupils and teachers have bought them, and they are doing well with them. However, we could not do that before a careful study of its educational validity. We are considering some options, but we have not come to a final decision. We are very careful, as this will be a large project and we have first to look at other people's experience, especially those in the developed countries. We will start where the other left off.

*Q13.What about the machines? You mentioned that you will install computers sets in secondary schools throughout the Kingdom starting from next year. Do you have enough machines for each school?.*

A13.We have no financial difficulty now. We can spend enough money to buy machines and to construct computer rooms. We can do that in a couple of months.

*Q14.What is the computer room?.*

A14.Yes, by the next year we will have a special room designed for computers in each secondary school.

*Q15.A final question. Can I ask about who will choose these machines and who will decide how they are to be used?.*

A15.We have a committee here in the Ministry which also includes some specialists from the SA Universities. Of course, they will select machines that suit our purposes, as well as considering other factors, like, for example, high quality, reasonable price, simplicity to operate and maintain, etc.

*Thank you very much indeed; and I am very pleased to invite you to give your suggestions and your recommendations related to the subject.*

Yes, we are here in the educational development directorate are looking for practical studies. There is no doubt that most studies are left on the shelves. I think that is because they are not closely related to our real educational problems or they have not provided practical solutions to the problems. To be more clear, we are going to change the computer curriculum next year according to one good study which gives us all possible options.

## Appendix H: INTER-ITEM CORRELATIONS FOR CSTQ SCALES

| Correlations: | 5 | 9 | 12 | 14 | 24 |
|---|---|---|---|---|---|
| 5 | 1.0000 | .1085 | .0037 | -.1325 | .0883 |
| 9 | .1085 | 1.0000 | .2638 | -.1349 | .1113 |
| 12 | .0037 | .2638 | 1.0000 | .5217** | .5615** |
| 14 | -.1325 | -.1349 | .5217** | 1.0000 | .3658 |
| 24 | .0883 | .1113 | .5615** | .3658 | 1.0000 |

1-tailed Signif: * - .01 ** - .001

Item correlation for the scale TRAININGA of the CSTQ

| Correlations: | 2 | 3 | 6 | 8 | 10 | 13 |
|---|---|---|---|---|---|---|
| 2 | 1.0000 | .1713 | .0032 | .3334 | .2621 | .0579 |
| 3 | .1713 | 1.0000 | .3234 | .2788 | .3988* | .1785 |
| 6 | .0032 | .3234 | 1.0000 | .3056 | .1871 | .1326 |
| 8 | .3334 | .2788 | .3056 | 1.0000 | .3925* | .4593* |
| 10 | .2621 | .3988* | .1871 | .3925* | 1.0000 | .3147 |
| 13 | .0579 | .1785 | .1326 | .4593* | .3147 | 1.0000 |
| 15 | .0851 | .1155 | .4760* | .1051 | .2426 | .2673 |
| 16 | -.0259 | .2473 | .1946 | .2464 | .0248 | .3398 |
| 17 | .0555 | .4735* | .3792* | .3437 | .2542 | .0373 |
| 20 | -.0637 | .4148* | .2759 | .1607 | .3864* | .3541 |
| 21 | .1604 | .4876** | .2697 | .4815* | .0825 | .0653 |
| 23 | .2464 | .3124 | .0992 | .3033 | .2964 | .3109 |
| 25 | .0502 | .5995** | .4200* | .5557** | .3881* | .1953 |

| Correlations: | 15 | 16 | 17 | 20 | 21 | 23 | 25 |
|---|---|---|---|---|---|---|---|
| 2 | .0851 | -.0259 | .0555 | -.0637 | .1604 | .2464 | .0502 |
| 3 | .1155 | .2473 | .4735* | .4148* | .4876** | .3124 | .5995** |
| 6 | .4760* | .1946 | .3792* | .2759 | .2697 | .0992 | .4200* |
| 8 | .1051 | .2464 | .3437 | .1607 | .4815* | .3033 | .5557** |
| 10 | .2426 | .0248 | .2542 | .3864* | .0825 | .2964 | .3881* |
| 13 | .2673 | .3398 | .0373 | .3541 | .0653 | .3109 | .1953 |
| 15 | 1.0000 | .3468 | .1110 | .0029 | -.0131 | .1158 | .1040 |
| 16 | .3468 | 1.0000 | .3262 | .0688 | .5117** | .0286 | .3662 |
| 17 | .1110 | .3262 | 1.0000 | .2100 | .6670** | .2305 | .5964** |
| 20 | .0029 | .0688 | .2100 | 1.0000 | .0682 | .2183 | .2039 |
| 21 | -.0131 | .5117** | .6670** | .0682 | 1.0000 | .1604 | .4945** |
| 23 | .1158 | .0286 | .2305 | .2183 | .1604 | 1.0000 | .3531 |
| 25 | .1040 | .3662 | .5964** | .2039 | .4945** | .3531 | 1.0000 |

1-tailed Signif: * - .01 ** - .001

Item correlation for the scale ST. TRAININGA of the CSTQ