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**Educating Prospective Science Teachers in Oman:  
Evaluating Initial Training Programmes**

**By**

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This thesis is presented to the degree of Doctor of Philosophy in science education

Department of Science Education

Institute of Education

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## Declaration

This thesis has been composed by the researcher and has not been used in any previous application for the degree. The results addressed in this research were obtained by the researcher under the supervision of Dr. Barker and Dr. Elliott. All the information has been specifically acknowledged by means of references.

*Abdullah Al-Tobi*

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## **Abstract**

### **Educating Prospective Science Teachers in Oman: Evaluating Initial Training Programmes**

This study has investigated the effectiveness of an initial teacher training programme provided by the Omani Colleges of Education in preparing science teachers. To understand the phenomena of this research, to give a picture as clear as possible of the topic under study and to determine the information that needs to be collected, a framework was established.

A combination of qualitative and quantitative tools (questionnaires, interviews and document examination) was used to meet the aims of this study. The questionnaires and interviews were designed and tailored to relate specifically to the teachers' competencies that are required by the Omani Reformed General Education (the Basic Education: Stage Two). In addition, the importance and effectiveness of the programme's components were also investigated.

The questionnaires were conducted with all the student science teachers in the final academic year, 2000/2001, and all the teacher educators in the departments of educational studies in all the six Omani Colleges of Education. Sub-samples of student teachers and teacher educators were interviewed. In addition, some newly qualified teachers were also interviewed.

To carry out a careful analysis, a framework of data analysis was developed. The results are divided into three main sections. The first section addresses student teachers' competencies. The second section reports the participants' evaluation of the importance and effectiveness of the pedagogical courses. The third section covers the respondents' evaluation of the importance and the effectiveness of practicum aspects. In addition, results that emerged from the two last open-ended questions in the questionnaires and interviews and the effects of some variables on student teachers' competencies are presented.

This study has indicated that while student science teachers demonstrated their ability in some competencies, they were deficient in the majority. In general, the results have indicated that approximately 86.96% of the competencies were rated to be average whereas only 10.87% of these competencies were viewed to be above average (i.e. competent). In addition, the majority of responses indicated that student teachers could use some experiential learning methods and some different assessment tools to a limited extent but not effectively. Furthermore, student science teachers are not fully prepared to use a problem-solving approach and ICT in teaching science.

This research has produced interesting and useful data about the student teachers' competencies and the curriculum of the colleges and the manner in which it was implemented. It has not only shown a serious gap between the actual needs of science teachers (importance) and their preparation (effectiveness) by the colleges but identified also the areas of weakness. Some factors affecting the acquisition of the student teachers' competencies are addressed.

Recommendations have been made for the Ministry of Higher Education for the development of the existing science teacher education programmes, and for the Ministry of Education (in-service teacher training). Issues for further research are also addressed.

## **Dedication**

I dedicate this project to my country, family and all those concern who supported me by encouragement and example.



**CHAPTER ONE: STATEMENT  
OF RESEARCH PROBLEM**



# **CHAPTER ONE: STATEMENT OF RESEARCH PROBLEM**

## **1:1 Introduction**

The purpose of this research is to make an evaluation of the science teacher preparation programme provided by the Colleges of Education in Oman. The evaluation is informed by the perspectives of student teachers, newly qualified teachers and teacher educators.

## **1:2 Organisation of the Thesis**

The thesis contains six chapters. The purpose of the first one is to introduce and state the research problem and the research framework. The second chapter gives a profile of the general education and the teacher education in Oman. The literature review is presented in chapter three, and the methodology of research is in chapter four. Chapter five covers the results of the study. The results are divided into: a) student teachers' competencies in teaching, assessment and evaluation and their competencies at using problem solving in teaching science, b) the importance and effectiveness of pedagogical courses in the training c) the importance and effectiveness of practicum aspects in the training and d) other results. Chapter six addresses the discussion of the results and the recommendations, and it highlights issues for further investigations, and the conclusion of the research.

## **1:3 Statement of the Research Problem:**

The Ministry of Education in Oman has recently (1998) introduced a new science curriculum in its schools of the general education. In this reformed general education, there are two levels: the basic education which contains two stages (stage one: 6-10 years old and stage two: 11-16 years old) and the secondary education: 17-18 years old. Science teachers graduating from the Colleges of Education which are run by the Ministry of Higher Education, are expected to be able and competent to teach in this reformed system.

Teacher education programmes need to focus on the demands and needs of the schools (Manouchehri, 1997; Strawderman & Lindsey, 1995 & Webber, 1996). Manouchehri (1997) argues that the need for competent and skilled teachers will become more acute if the school curriculum changes.

The teacher is one of the most important elements of a developing educational system and at the heart of educational improvement (Al Busaidi & Bashir, 1997 and Hopkins & Stern, 1996). Fitzsimmons and Kerpelman cited in Wise, Spiegel and Bruning (1999) argue that any systematic reform effort must focus on classroom teachers because they have the greatest capacity to influence the educational change. Evaluation too is seen as an essential part of the process of improving education in general and teacher education in particular (Ashburn, 1987; Chapman, 1990; Murray, 1990). Galluzzo and Craig (1990) state four purposes for conducting evaluation studies in teacher education: a) accountability; b) improvement; c) understanding and d) knowledge production (p. 605). They argue that the purpose of improvement is consistent with most of the scholarly writing in educational evaluation.

Thus, the evaluation of science teacher preparation programmes at the Omani Colleges of Education is justified in order to ensure that these programmes are effective in preparing skilled teachers. In addition, this evaluation is important because there is a need to find out that teachers graduating from these colleges are able to achieve the requirements of the new science curriculum as reformed by the Ministry of Education in Oman. This evaluation makes special reference to student teachers' competencies of teaching, assessing and evaluating of science, and the competencies of using the problem-solving method in teaching science. The focus on these aspects is made because the Reformed General Education pays particular attention to these competencies and the problem-



solving-method is the main strategy of teaching science in this reformed system (Ministry of Education, 1995; 1999a; & 1999b). In addition, the importance and effectiveness of the components of the science teacher preparation programme (pedagogical courses and practicum aspects) are also considered in this evaluation.

## **1:4 Rationales of the Study:**

The need for this type of research emerges from a number of factors. Firstly, the introduction by the Ministry of Education of a new reformed general education which recommends that:

*the programme for science teachers at the Teachers' Colleges of Education should be revised to ensure that it provides a firm basis for teaching the new programme* (Ministry of Education, 1995: A3-18).

Fullan (1991) states that “*teacher development and school development must go hand and hand you cannot have one without the other*” (p. 289). Strawdeman and Lindsey (1995) and Webber (1996) also indicate that pre-service teacher training programmes should provide future teachers with the skills and knowledge they will need to work effectively with all pupils in schools.

The reform of general education needs highly qualified and competent science teachers in order to implement its requirements (Ministry of Education, 1995). The skills and competence of the teacher are the crucial priority in evaluating the quality of teacher education. Teacher education programmes can be seen as the most important component in providing the necessary teaching skills and knowledge to enable prospective teachers to educate pupils in schools effectively. Hence, it is essential that evaluation of teacher preparation programmes should take place so as to ensure that they provide teachers with a variety of teaching skills, an effective pedagogical knowledge and a strong background of teaching practice.

**Secondly**, to determine whether the stated aims and objectives of the Colleges of Education are achieved or not. One purpose of these colleges is to prepare Omani teachers to teach effectively in the various levels of primary, preparatory, and secondary education (Ministry of Higher Education, 1996). *(These objectives are addressed in chapter two)*. So, it is necessary to assess whether or not the science teacher programme has provided the student teachers with the skills needed for teaching at the levels of general education in line with the Ministry of Education's policy of improving the quality of teaching science.

**Thirdly**, there is a lack of research on teacher education in Oman, particularly the evaluation of teacher education programmes even at the most important educational institutions, the Colleges of Education, which are run by the Ministry of Higher Education (over 2000 teachers graduating per year). **Finally**, informal contacts with preparatory and secondary schools indicated that there has been a decline in the quality of teachers graduating from the Colleges of Education. Hence, it is crucial to find out whether the teacher preparation programme qualifies effective science teachers or not.

It is intended that the present research, in addition to evaluation, will allow recommendations to be made about highlighting good practice and how to reduce weaknesses (if any). It also reinforces the positive aspects of the science teacher programme with an ultimate goal of improvement.

## **1:5 Study Aims:**

The key aims are:

- to assess student science teachers' competencies/abilities in teaching science as needed to meet the guidance (requirements) of the Ministry of Education;

- to find out student science teachers' competencies/abilities in assessment and evaluation of science needed to meet the guidance of the Ministry of Education;
- to assess student science teachers' competencies/abilities in designing and implementing the problem-solving approach which is recommended by the guidance of the Ministry of Education as a main strategy for teaching science in the Reformed General Education;
- to determine the importance and effectiveness of pedagogical courses in preparing science teachers;
- to determine the importance and effectiveness of practicum aspects in preparing science teachers;
- to make recommendations to the Ministry of Higher Education on improving science teachers' preparation programme;
- to make recommendations to the Ministry of Education that will help to overcome any weaknesses of the science teachers who are already in the field of teaching; and
- to identify issues for further research in teacher education in Oman.

## **1:6 Research Questions:**

In order to accomplish the research aims, the following research questions were framed:

1. To what extent do student science teachers possess the competencies/abilities needed to ensure effective teaching?
2. To what extent do student science teachers possess the competencies/abilities needed to carry out effective assessment and evaluation?
3. To what extent do student science teachers possess the competencies/abilities that help them to apply a problem-solving method in their teaching of science?
4. Are the pedagogical courses important and effective in preparing science teachers (more specifically, what are the differences between the importance and the effectiveness of the pedagogical courses)?
5. Are the practicum aspects of training courses important and effective in preparing science teachers (more specifically, what are the differences between the importance and the effectiveness of the practicum aspects)?

## **1:7 The Framework of the Study**



The theoretical framework is important for any research because it acts as a guide for the rest of the research process. As Maxwell (1998) argues: the function of the theory in research design is

*to inform the rest of the design – to help assess your purposes, develop and select realistic and relevant research questions and methods, and identifying potential validity threats to your conclusions (p. 77).*

Mitzel (1982a) also states that “*the function of a model in evaluation is to provide a conceptual framework or a rationale for designing evaluation studies*” (p. 603). Thus, in any evaluation study, a systematic model should be established. So, to understand the phenomena of this research, to give a picture as clear as possible of the topic under study and to determine the information that needs to be collected, a framework (model) was established.

This framework is based on the objectives of this study, research questions, definitions of the programme evaluation and reviewing of the models of the programme evaluation. Figure 1:1 gives an overview of the theoretical framework of this study. It is designed to take account of seven aspects. These are as follows:

- the requirements of the Ministry of Education and the rationale of the study;
- literature review which gives a strong basis for the study;
- two types of evaluation: Outputs (Outcomes) and Process Evaluation;
- research questions related to the types of evaluation;
- methods of data collection;
- methods of data analysis;
- results, recommendations, and conclusion.

Literature Review	Types of Evaluation	Research Questions	Methods of data collection	Methods of data analysis	Results, recommendations and conclusion
Literature dealing with: <ul style="list-style-type: none"> <li>• Programme Evaluation</li> <li>• Models of programme evaluation</li> <li>• The importance of research in evaluating teacher preparation programmes</li> <li>• The needs of the schools and teachers' programmes</li> <li>• The components of teacher education programmes</li> <li>• Teachers' skills. And competencies</li> <li>• Problem-solving method</li> <li>• In-service training</li> </ul>	<b>Product Evaluation (outputs):</b> Student teachers' competencies of: <ul style="list-style-type: none"> <li>• Teaching of science;</li> <li>• Assessment and evaluation of science</li> <li>• Using problem-solving methods in teaching science</li> </ul>	<ul style="list-style-type: none"> <li>• Q1 (teaching competencies)</li> <li>• Q2 (assessment competencies)</li> <li>• Q3 (problem-solving competencies)</li> </ul>	<ul style="list-style-type: none"> <li>• Quantitative methods (questionnaires).</li> <li>• Qualitative methods: interviews &amp; questionnaires).</li> <li>• Documents</li> <li>• Triangulation</li> </ul>	<ul style="list-style-type: none"> <li>• Quantitative analysis</li> <li>• Qualitative analysis</li> <li>• Document examination</li> </ul>	<ul style="list-style-type: none"> <li>• The student teachers' competencies</li> <li>• The importance and effectiveness of the pedagogical and practicum components</li> <li>• The strengths and weaknesses of the programme</li> <li>• The recommendations to improve the programme</li> </ul>
<ul style="list-style-type: none"> <li>• Problem-solving method</li> <li>• In-service training</li> </ul>	<b>Process Evaluation:</b> <ul style="list-style-type: none"> <li>• Pedagogical courses</li> <li>• Practicum (teaching practice) aspects</li> </ul>	<ul style="list-style-type: none"> <li>• Q4 (importance and effectiveness of pedagogical courses);</li> <li>• Q5 (importance and effectiveness of practicum aspects)</li> </ul>	<ul style="list-style-type: none"> <li>• Quantitative methods (questionnaires).</li> <li>• Qualitative methods: interviews &amp; questionnaires).</li> <li>• Documents</li> <li>• Triangulation</li> </ul>	<ul style="list-style-type: none"> <li>• Quantitative analysis</li> <li>• Qualitative analysis</li> <li>• Document examination</li> </ul>	<ul style="list-style-type: none"> <li>• Recommendations to the Ministry of Education</li> <li>• Highlighting issues for further investigation</li> </ul>

Study rationales and the Requirement of the Ministry of Education

Figure 1:1 The framework of the study

Definitions of programme evaluation identified in the literature review (*Chapter Three*) indicate that programme evaluation is a systematic investigation of the worth and impacts of the programme. Galluzzo and Craig (1990) say that the worth of a teacher education programme would be the degree to which schools are satisfied with the quality of the newly qualified teachers. In other words, the quality of teachers is defined by the degree to which they have the competencies and abilities that help them to teach in the schools.

The systematic framework of this research consists of concepts derived from some evaluation programme models as discussed in chapter three. The idea of the rationales of the study was developed from Stake's countenance Model (cited in Galluzzo & Craig, 1990). The concepts of the types of evaluation, output and process evaluations, were adapted from the CIPP model (Stufflebeam, 1983) and the Stake's model (Galluzzo & Craig, 1990). The ideas of the criteria of the teachers' skills were taken from Dwyer's (1993) criteria.

This research investigates two types of evaluation: output and process evaluation. Output evaluation assesses selected teachers' competencies of teaching, teachers' competencies of assessment and evaluation and teachers' competencies of using the problem-solving method in teaching science that are required the Omani reformed education system. Process evaluation evaluates the importance and effectiveness of the pedagogical courses and practicum aspects.



**CHAPTER TWO: A PROFILE OF  
GENERAL EDUCATION AND  
TEACHER EDUCATION IN OMAN**

# CHAPTER TWO: A PROFILE OF GENERAL EDUCATION AND TEACHER EDUCATION IN OMAN

## 2:1 Historical Background

Oman is one of the Middle Eastern Arab countries. It is situated on the south-eastern end of the Arabian peninsula. Its land area is 309,501 square kilometres. It borders Saudi Arabia and the United Arab Emirates in the west; the Republic of Yemen in the south; the Strait of Hormuz in the north and the Arabian Sea in the east (Ministry of Information, 1999).

Before 1970, Oman, with its Islamic tradition, lived in quiet isolation from the rest of the world for more than three decades. During this time, the Omani people were denied many basic services such as health, communication, transportation and, most importantly, education. Oman was unknown to many people around the world because the former Sultan kept the whole nation weak in order to secure his position. He maintained this policy throughout those decades. He did not trust any one and was suspicious of being overthrown, even by his closest relatives (Al Salmi, 1994 & Al Salmi, 1996).

In 1970 there were only three primary schools in the whole of Sultanate located in Muscat, Muttrah and Salalah with a total of 909 boys and 30 teachers (Ministry of Information, 1995). In addition to this limited primary education, there were traditional religious and Koranic schools that provided religious education and taught the verses of the Koran. Girls were not restricted from this form of education. They joined boys in learning the Koran in Koranic schools which were located in most villages (Al Salmi, 1996).

In summary, prior to 1970 education in Oman exhibited the following points:



- there was an extremely limited primary education in Oman;
- there were no preparatory schools, secondary schools and no universities;
- there was no provision for the education of girls except the traditional religious education; and
- there were no institutes for training teachers.

On 23<sup>rd</sup> of July 1970, Oman witnessed a radical shift when the present Sultan became the leader of the Country. From that time until now, rapid and remarkable developments have been witnessed in different aspects of life in Oman. Education has been given a high priority in the development of the Sultanate of Oman (Ministry of Information, 1999). The following sections give an overview of the development of the general education and teacher education in Oman.

## **2:2 Part One: General Education**

This section describes the background of the Omani general educational system. It deals firstly with the previous general education system and secondly with the reformed general education.

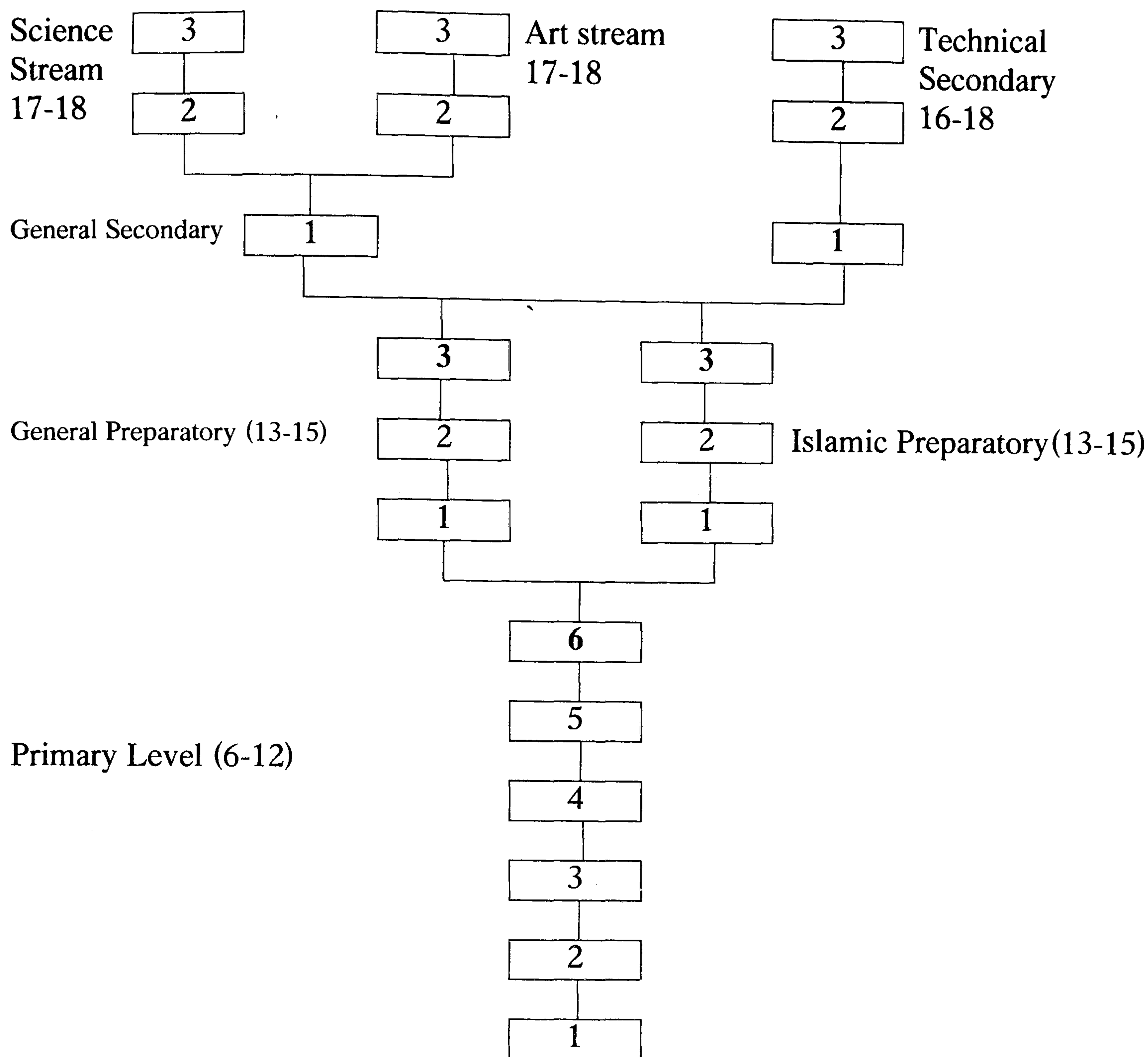
### **2:2:1 The Structure of the Previous General Education in Oman:**

The educational authorities in Oman argue that the main objective of the first phase of educational development was to spread education all over the country as quickly as possible. This was in order for most school age children to benefit from some kind of modern education and as his Majesty declares (Ministry of Information, 1990):

*Education was my first concern, and I saw that was necessary to direct efforts to spread education. We have given the Ministry of Education the opportunity and supplied it without capabilities to break the chains of ignorance. Schools have been opened without taking into account the requirement. The important things that there should be education, even under the shadow of trees (p. 36).*

Thus, the number of schools significantly increased from **three** primary schools with 909 pupils before 1970 to **996** schools with 555,393 pupils in the year 2000/2001 (Ministry of Education, Web Site: [www.Edu.gov.om](http://www.Edu.gov.om) 15/5/2002). The general education system in the Sultanate of Oman has been based on a 6-3-3 pattern. This consists of six years' primary, three years' preparatory and three years' secondary education. Figure 2:1 gives an overview of this system. The school academic year lasts about 32 weeks, and is divided into two semesters. The timetable for primary and preparatory schools contains 30 periods per week/6 per week while in secondary schools there are 35 periods/7 per week. Each period lasts 40 minutes for one-shift and 35 minutes for two-shift primary scho/7 per weekols, 40 minutes for preparatory and 45 minutes for secondary schools (Alkindi, 1997).

Thus, some school buildings are used for two shifts, one in the morning and the other in the afternoon. This is because the shortage of school buildings and to accommodate all students. The science periods of primary, preparatory, and secondary are illustrated in the tables 2:1 and 2:2.



**Figure 2:1 The previous Omani General Educational Structure (it is still applied up to 2006/7)**

**Table 2-1 The previous Omani primary and preparatory science's periods per week (it is still applied up to 2006/7)**

Stage	PRIMARY						Preparatory		
Grade	1	2	3	4	5	6	1	2	3
Periods	2	2	3	3	3	3	4	4	4

Adapted from (Al busaidi, 1999)



**Table 2-2 The previous Omani secondary science's periods per week (it is still applied up to 2006/7)**

Stage	1 <sup>st</sup> Secondary	2 <sup>nd</sup> Secondary (Science)	2 <sup>nd</sup> Secondary (Arts)	3 <sup>rd</sup> Secondary (Science)	3 <sup>rd</sup> Secondary (Arts)
Physics	2	4	---	4	---
Chemistry	2	3	---	3	---
Biology	2	3	---	3	---
General Science	---	---	2	---	2
Total	6	10	2	10	2

Adapted from (AlBusaidi, 1999)

### **2:2:1:1 The content of the Science curriculum:**

The Ministry of Education (1995) argues that the previous science curriculum in Oman has too much content, especially theoretical content, much of which lacks relevance to the pupils or their immediate environment. This curriculum is divided into separate units, which includes some activities and practical work. However, most of these activities are not implemented. This is because of, as Alkindi (1997) stated, the shortage of laboratories and learning resources centres in schools as well as the bias towards theory rather than practical activities, dictated by the pressure of examinations.

### **2:2:1:2 The Teaching and Assessment Methods:**

The teaching in the previous system is largely didactic. Rote learning is taken as a sign of pupils' understanding of the lesson. The textbooks are the one and the only means of learning for the pupils and the only resource for the teacher. Sometimes, there are some practical activities but most of them are experiments, done through demonstrations by the teachers themselves and there is a limited opportunity for pupils to practise any activities. Pupils simply memorise the information and knowledge that help them to pass the exams.

Pupils in primary schools are assessed by oral and written monthly tests and final examinations. Pupils in preparatory and secondary schools are assessed by a mid-term written exam, daily work (exercises, oral tasks and activities relevant to the subject) and

the end-semester written exam. At the end of each semester of the third secondary year, which is the last year of the previous general education, students are assessed by the national examinations of secondary certification. The average of the results of these examinations is the student's score, which is a passport to the university or any of the other higher educational institutions (Alkindi, 1997).

In conclusion, the methods of teaching and assessment in the previous system has emphasis on rote learning while at the same time providing too little opportunity for experimentation and learning through tangible experience. In addition, this leads to little pupil/teacher interaction and little independent learning by pupils. Thus, the science curriculum does not adequately relate to pupils' needs (Alkindi, 1997). This focused attention on the need to reform science education.

In addition, the challenges facing the Sultanate of Oman, particularly the need to keep pace with scientific and technological changes, also requires new educational methods to prepare Omani children for life and work in the new conditions created by the present modern global economy (AlZakwani, 1997 & Ministry of Education, 1999a). Thus, the Ministry of Education started to reform its general education in 1998.

### **2:2:2 The Reform of General Education**

It is important to mention that the Omani Government adopts a five-year plan system in its planning. The first five-year plan was from 1976 to 1980. In the fourth-year plan (1994), the Ministry of Education prepared a report of the obstacles that were facing it in developing education and some suggestions of how to improve the quality of the education system (AlBelushi & AlKitani, 1997). This and other reports from other ministries were brought up in the "Oman 2020, The Vision Conference for Oman's Economy" held on



June 3 to 4, 1995. Four major themes were developed at the conference (Ministry of Development, 1995):

- an efficient and competitive private sector;
- a diversified dynamic and globalised economy;
- well developed human resources;
- sustainable development within a stable macro-economic framework.

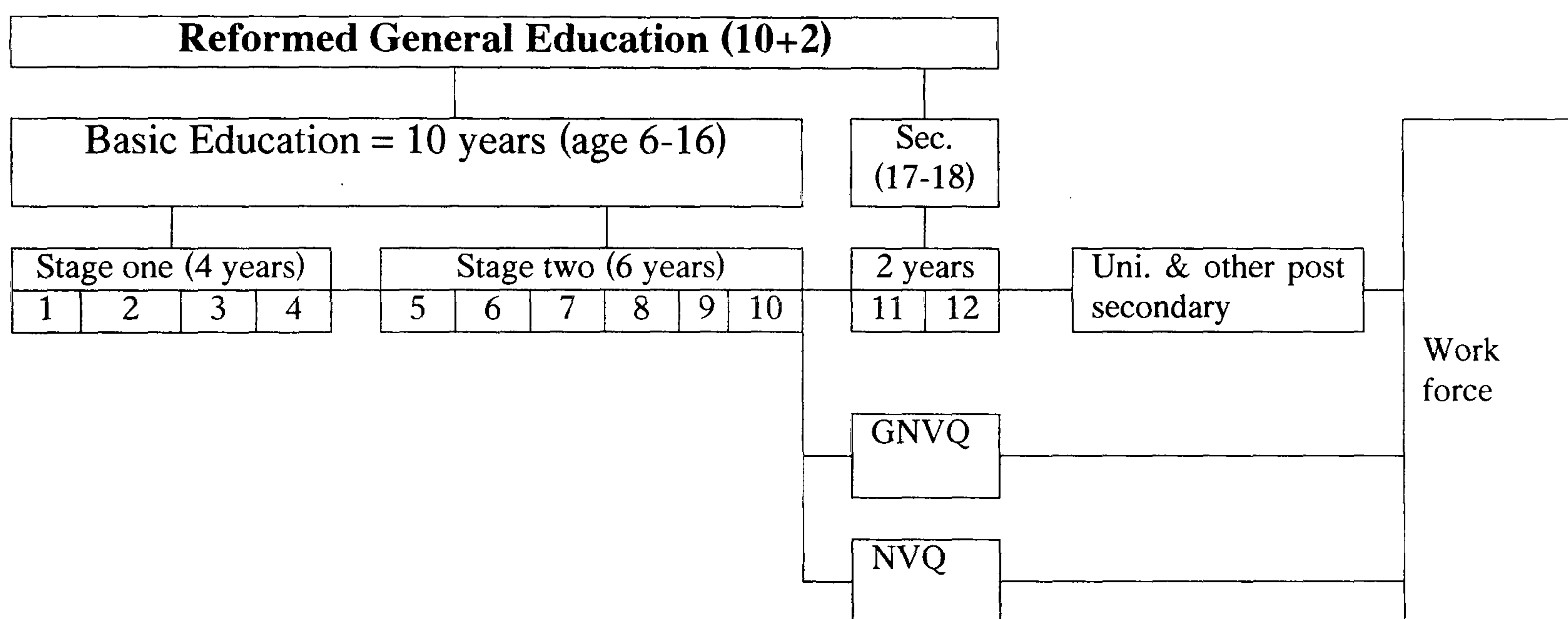
Undoubtedly, each of these themes points to the need to strengthen and improve the education system to prepare the youth of the nation to live and work in the modern world.

As The Ministry of Education (1995) reports: the national education system is one of the most important instruments for the implementation and achievement of national development goals and objectives.

Therefore, the five-year plan of 1996-2000 has focused on the development of human resources. The Government suggested recommendations to the Ministry of Education, which included goals to be met by the Ministry of Education (Ministry of Development, 1995). These goals are to:

- continue spreading education in all parts of the country;
- improve the current curricula taking into account what is current in science and technology advancement;
- improve the educational practices and to include current technology in education;
- advance staff development technically and administratively;
- create a basic education that can prepare students to continue their education or join the work force; and
- prepare students that can join the work force with minimum training.

In order to achieve these goals, to improve the quality of education, and therefore to prepare Omani students for life and employment in the 21<sup>st</sup> century, the Ministry of Education issued a plan to improve the education in Oman. After studying different new educational reforms, the Ministry of Education came up with the present reformed education that takes into account the challenges in science and technology in today's world, and the Omani educational philosophy and culture (AlBelushi & AlKitani, 1997). This reformed system is divided into two main stages: Basic Education (10 years, 6-16 year old) and Secondary Education (2 years, 17-18 year old). Figure 2:2 gives an overview of this system structure.



**Figure 2:2 The new structure of the reformed education system in Oman, adapted from the Ministry of Education (1995)**

Thus, The Ministry of Education started introducing and implementing the Basic Education system in 1998/1999 in 17 schools in the entire country. There will be a gradual increase in the number of schools each year until this reformed education system completely replaces the previous system by the academic year 2006/07.

It is worth mentioning that the new reform covers many different areas. Some of these are (AlBelushi & AlKitani, 1997 & Ministry of Education, 1995):

- developing the aims of education;

- improving the curriculum;
- providing Learning Resources Centres in all schools
- providing science laboratories;
- introducing computers in schools;
- strengthening the teaching and learning of science;
- strengthening the teaching and learning of mathematics;
- introducing English Language from grade one;
- changing ways of assessment;
- upgrading teachers' qualifications;
- demolishing the afternoon school system;
- expanding the school year and day;
- improving various education practices as a result of the new educational goals and so forth.

For the purpose of this research, the focus will be on the science curriculum, and the strengthening of teaching and learning of science. As AlBelushi & AlKitani (1997) and Ministry of Education (1995 & 1997b) argue, the improvement in the new curriculum looks at different aspects but the main ones are the content of the curriculum, teaching/learning methods and assessment/evaluation tools.

## **2:2:2:1 Some Features of the Basic Education Curriculum of Science**

### **a) The Aims of Reformed Science Curriculum:**

These aims are (Ministry of Education, 1999a) to:

- *deepen their Islamic faith through the study of science by leading them to observe their world and appreciate the greatness of God's creations;*
- *develop an interest in the environment and realise the need for humans to live in harmony with nature;*



- *be committed to the wise use of the natural resources of Oman and realise that all people of the world must work together to conserve natural and human-made resources;*
- *develop the processes or thinking skills in science. These processes involve skills such as observing, classifying, communicating, predicting and experimenting;*
- *have the facility to solve problems through science. Students must be given opportunities to use scientific information, concepts, and thinking skills to solve problems search conclusions. They should develop the ability to apply personal and social values to the process of decision making;*
- *acquire the basic knowledge needed to function in a world in which science has contributed to such a great extent to technology. This involves the acquisition of a level of scientific literacy that will allow them to interact with nature and the technological world, and contribute societal issues;*
- *be able to locate and retrieve scientific information through books, journals, as well as using technologies such as computers, computer-assisted telecommunications and other media forms;*
- *develop good hygienic habits and gain knowledge and understanding about good nutrition as well as public health and safety;*
- *be aware of career possibilities in the fields of science and technology; and*
- *to help students to recognise the achievements of scientists (pp. 29-30).*

The aims mentioned are stated for the new science curriculum of the basic education from grade 1 to grade 10.

## **b) Science Curriculum Contents**

The five main changes to the content of the science curriculum are: reducing the theoretical and abstract content; connecting the material to the pupils' lives; connecting the curriculum to the pupils' environment; aligning the content and the plan of the curriculum with the pupils' level at each educational stage; and reflecting the country's educational philosophy and giving students an opportunity to experience new technologies (Ministry of Education, 1999a).

In the programme of reformed basic education, the Ministry of Education believes that to implement the reformed curriculum, it is important to provide adequate time (Ministry of Education, 1995 & 1997a). Therefore, the number of total hours per week and per year was



increased. Table 2:3 shows the number of science topics and periods in each grade. In the time provided, pupils demonstrate an understanding of a group of science topics. Appendix (1) gives an overview of these topics.

**Table 2-3 The number of science topics and periods in each grade of the Omani reformed basic education**

Grade	Number of topics	Number of Periods/week
1	5	3
2	5	3
3	4	3
4	5	5
5	5	5
6	5	5
7	4	6
8	4	6
9	5	6
10	9	8

Adapted from the Ministry of Education (1999a)

Thus, the periods per week for science have been significantly increased at each grade level over the 10 years of the basic education. The percentage of the increase in the periods of science is 59%. This substantial increase in time on science combined with the proposed changes to the curriculum, teaching methodology, textbooks, learning aids, facilities, and other components, will work to upgrade pupil achievement and improve the quality of science education.

In addition, teachers in this system have the freedom to add or to discard some activities depending on the time available and pupils' environment, interest and their needs (Ministry of Education, 1998).

### **c) Teaching/Learning Methods**

With regard to learning/teaching methods, there are also changes. These are examples of these changes (Ministry of Education, 1995):

- teachers are advised not to use rote memorisation;

- emphasising on learning through direct personal experience, achieved through greater use of:
  - student-performed activities and experiments;
  - manipulative and concrete materials in every classroom;
  - out-of school trips and visits;
  - organising science learning through games;
  - guiding pupils to use collaborative learning;
  - independent student activities, and assignments and projects;
  - emphasising on the use of thinking skills in problem solving; and
  - encouraging self-learning rather than through the medium of the teacher;
- use of technologies such as computers; and
- choosing activities and assignments that meet the learning needs of the pupils.

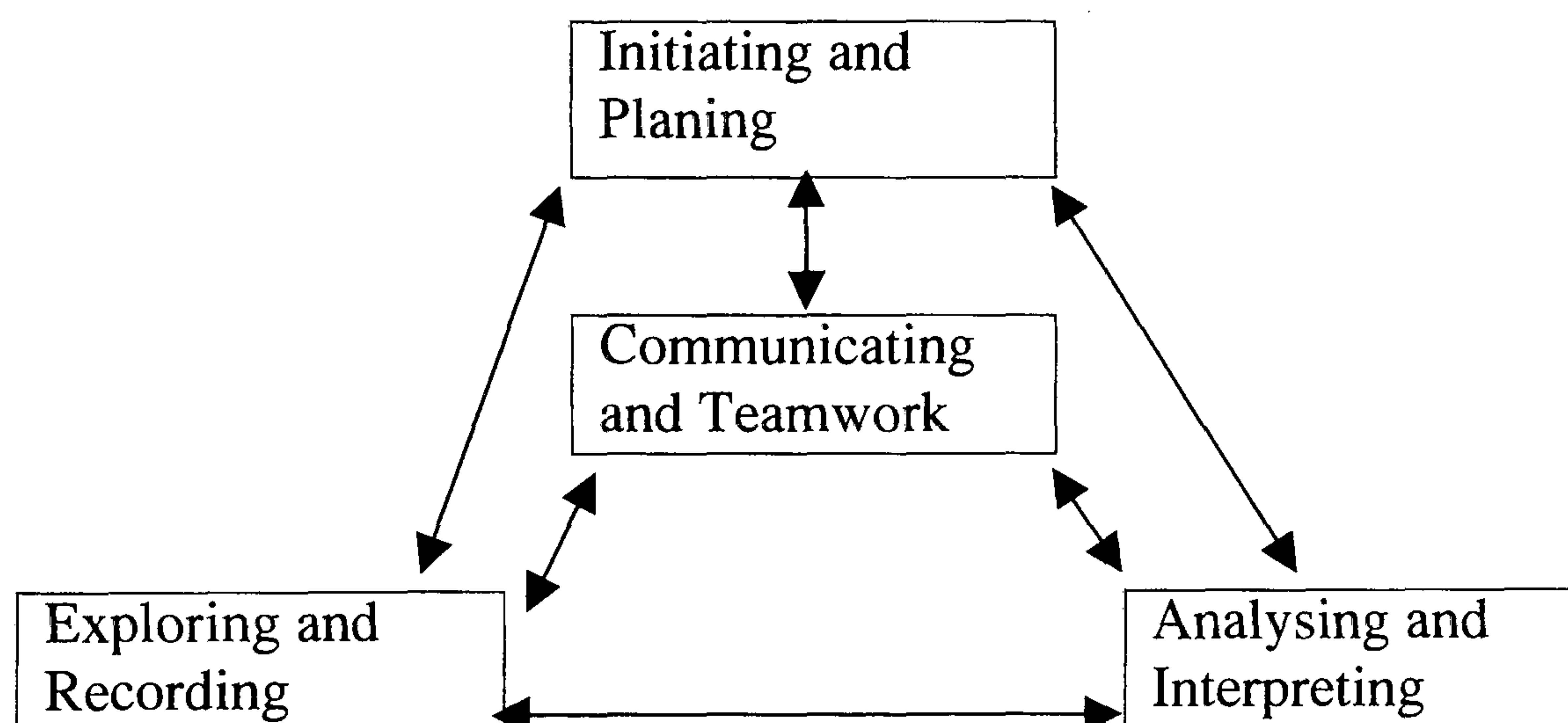
Thus, the following principles are addressed to guide and support decisions relating to the learning and teaching processes of science (Ministry of Education, 1999a):

- pupils should be viewed as individuals who develop and learn via different styles and at different rates;
- pupils benefit, both socially and intellectually, from a variety of learning experiences, both independently and in collaboration with others;
- pupils learn best in an environment which supports exploration, investigation, critical and creative thinking, risk thinking, reflection and other higher thinking skills;
- pupils learn best when ideas are approached in a variety of ways;
- pupils learn best in an environment that nurtures positive attitudes, sustained effort, self-discipline and the development of an appropriate degree of autonomy;
- pupils' learning is most effective when standards of expectation are made clear and explicit.

#### **d) Problem Based Learning**

The reformed system focus on “experiential learning” as a process of basing the learning of the pupil on his or her own direct experience. Experiential learning is a particular application of problem-based learning.

In this approach, pupils use a wide variety of skills to solve problems and make informed decisions. The Ministry of Education (1999a) addresses a model for science lessons, which describes these skills. The skills can be grouped into four broad categories. Each category of skills is developed with increasing scope and complexity of application from grade one to grade ten. This model is illustrated in Figure 2:3.



**Figure 2:3 The model of problem-solving skills (Ministry of Education, 1999a)**

It is not an intention for this model to be used as linear sequence or to be memorised as a scientific method. Rather, teachers are advised to use this model as a way to organise their teaching and ensure the pupils become capable and competent in science.

It can be understood that the skills of problem solving are a major focus of science at all grade levels. The development of each pupil’s ability to solve problems is essential. Pupils



should develop a true understanding of concepts and procedures when they solve problems in a meaningful context.

**e) Assessment and Evaluation of Science:**

In the reformed system, assessment and evaluation are essential parts of the learning and teaching process. This system concentrates on authentic and effective assessment (Ministry of Education, 1999a). According to Hart (cited in AlBelushi & AlKitani, 1997) assessment is authentic when it involves pupils in tasks that are worthwhile, significant and meaningful. Such assessments look and feel like learning activities, not traditional tests.

Although the terms “assessment” and “evaluation” are often used interchangeably, they are in fact separate processes. The Ministry of Education, in its reformed system, defines these terms as follows (Ministry of Education, 1999b):

*Assessment is “the process of gathering evidence of a student’s attainment. Its purpose is to determine what a student is actually achieving in relation to agreed criteria”, whereas evaluation is “the process of making a judgement about assessment information”. (p. 1)*

In addition, the reformed science programmes address the following needs for effective assessment and evaluation (Ministry of Education, 1995 & 1999a):

- less reward for the simple memorisation of content;
- greater stress on the applications of material to the lives of the pupils;
- greater effort to include higher-order thinking skills in student assessment;
- assignments should be meaningful extensions of the concepts taught in class; and
- methods of assessment must be on-going and continuous every day.

Thus, assessment and evaluation and the uses to which they are put cannot be separated from learning and teaching. It is helpful to consider these terms together by addressing the following principles (Ministry of Education, 1999b):



1. Assessment should be a planned activity.
2. Assessment and evaluation should arise naturally and occur frequently and informally in the day-today teaching process.

Therefore, assessment in science takes place during teaching when the teacher:

- finds out how well the pupils are achieving (e.g. by asking questions, setting tasks; looking at written work or observing activities);
- provides feedback to pupils while they are working;
- provides feedback to pupils about previous work (e, g., by returning written work or recalling an earlier lesson); explains to pupils what they are expected to know or to be able to do as the results of an assignment or lesson.

As a result of what pupils say, write or do, evaluation for science takes place when the teacher:

- makes a judgement about how well the pupils have achieved the required outcomes for a reporting period or for the year;
- determines what is required for a pupil to meet a given standard or performance.

3. The progress of individual pupils should be updated and recorded in a convenient way.

This is achieved by using various types of checklist, individual profiles and self-assessment sheets.

4. Feedback should be reported to pupils, parents, other teachers, and administrators.

In addition, the reformed system implements performance assessment, in which it asks pupils to solve problems using prior knowledge (Ministry of Education, 1995 & 1999a). As the Ministry of Education (1999b) reports: to improve the problem-solving abilities of pupils as they progress through the grades, pupils must progressively develop their skills in observation, classification, measuring, inferring, predicting, hypothesising, experimenting, controlling variables, interpreting data, making models, and communicating. So, the assessment should focus on these skills.

It is concluded that the teacher in the classroom has the daily responsibility for pupil formative and summative assessment. The teacher is at the forefront in determining pupils'

progress using evaluative practices that include careful planning, appropriate assessment strategies and good professional judgement.

## **2:3 Part Two: Teacher Education**

Teacher education in Oman has been based on the demands of the general education system. It has developed through different stages in relation to the needs of the Ministry of Education to fill teaching positions in general schools. This section deals with how the general education has affected the development of teacher education.

In order to address the urgent need for teachers in 1970, the Ministry of Education had no choice other than recruiting people with low qualification, those who taught in Quranic schools and those who came back from neighbouring countries after the coup (Al Salmi, 1994). To make up for the shortage of teachers, expatriate teachers were recruited.

Within the context of teacher education, the Ministry of Education started, in 1975/76 to train a first group of 25 Omani teachers after they had finished their grade 7 of general education. The period of the training was two years. In 1977/78, Teacher Training Institutions (TTIs) with three-year training programmes for grade 9 school-leavers were opened. In 1979/80 the one-year training system was included as an *ad hoc* programme for secondary school-leavers (Al Busaidi & Bashir, 1997). It is concluded that because of the acute shortage of Omani teachers at that time, the Ministry of Education was offering every possible opportunity to qualify Omanis for such positions.

Thus, the Ministry of Education felt that the TTIs were unsuitable to train teachers to a satisfactory standard because it accepted students who had only nine years of general education and were too young for teaching jobs (Al Busaidi & Bashir, 1997). As a result of



this, in the academic year 1984/85, these institutions were developed into Intermediate Teacher Training Colleges (ITTCs) delivering two-year programmes to secondary school-leavers. Teachers were trained either to teach in grades 1-3 as classroom teachers or subject teachers for grades 4-6 of the primary schools. There were nine colleges, five were to train male teachers and four were to train female teachers.

The College of Education and Islamic Science at the Sultan Qaboos University has been delivering teacher education programmes at BA (undergraduate Bachelor) level for preparatory and secondary levels of schooling since 1986/87 (Al Busaidi & Bashir, 1997). Thus, the first group of Omani preparatory and secondary teachers graduated in 1990/91. In the system of this university, the student teachers should successfully complete seventy-two credits in specialist subjects, eighteen credits of general education requirements such as Arabic and computer studies, and forty two credits of educational requirements in psychology, teaching methods, curriculum, practical training of teachers in groups and teaching practice in schools (Alkindi, 1997). Furthermore to that, the Institute of Education was established in 1991 to offer a 1-year training for non-educational bachelor degree holders so as to teach at preparatory and secondary general education.

In summary, the following areas can be addressed:

- the elementary schools of general education were almost Omanised through the graduates of the ITTCs;
- the number of graduates from the Sultan Qaboos University was still not enough to cover the increased demand for preparatory and secondary teachers in Oman.

In addition, some empirical studies indicated a need for consistency across teacher education for the various levels of education and upgrading the ITTCs into the Colleges of Education offering a B. Ed degree (Al Salmi, 1994 & Isan, 1995).



Thus, in the academic year 1995/96, six of the ITTCs were upgraded to 4-year university level colleges, “the Colleges of Education”. The Royal Decree No. 79/95 was issued to transfer the supervision of these colleges to the Ministry of Higher Education. The following discussion deals with these colleges.

### **2:3:1 Colleges of Education**

The development of these colleges has reflected the Oman’s educational policy during the present and for the next stage, which has focused on covering the increased demand of preparatory and secondary teachers and on the reformed general education.

There are six colleges spread around the Sultanate, two for male students in Nizwa and Sohar, two for female students in Rustaq and Ibri, and two coeducational colleges in Sur and Salalah. The following discussion covers some aspects of these colleges.

#### **2:3:1:1 Aims of Colleges of Education**

The Colleges of Education aim to prepare generations of Omani teachers to teach in the various levels of primary, preparatory and secondary education thorough the realisation of the following objectives (Ministry of Higher Education, 1996):

- ensuring cohesion and consistency of a university level of teacher education for the various levels of schooling , with the aim of upgrading the quality of primary school teachers;
- expediting Omanisation of teaching posts at the various level of education particularly at the preparatory and secondary levels;
- enhancing student-teacher’s competencies in teaching at the various levels and their active participation in co-curricular activities as well as encouraging an effective role in the development of the local community;
- promoting and upgrading the level of teaching of scientific subjects (sciences, maths and technology) in the line with the scientific and technological progress at the time;
- investing college material and human resources in the professional in-service upgrading of the educational sector staff: teachers, supervisors, administrators and educational leaders, through the organisation of training courses and workshops;
- planning and implementing community development services projects;

- conducting and disseminating educational research to enrich the teaching/learning process.

In order to achieve these objectives, many programmes are implemented at the Colleges of Education. The following section explains some of these programmes.

### **2:3:1:2 College Programmes**

These colleges have been given the responsibility of pre-service training of teachers in various specialisations in order to meet the actual requirements of education in Oman. The programmes offered are as follows:

#### **1) Programme for preparatory and secondary teachers:**

The BA in education programme for preparatory and secondary teachers started in the academic year 1994/1995. The colleges offer the following specialisations (Ministry of Higher Education, 1996):

Islamic Studies	Arabic Language
Geography/History	History/Geography
Physics/Chemistry	Chemistry/Physics
Physics/Mathematics	Physics/Computer
Chemistry/Biology	Biology/Chemistry
Mathematics/Physics	Mathematics/Computer

These programmes also are to train science teachers for the new reformed system (Stage Two in the Basic Education, and secondary education).

The Biology/Chemistry programme has been postponed due to the sufficient number of teachers who have graduated from the College of Education and Islamic Science at Sultan Qaboos University (Al Busaidi & Bashir, 1997).

#### **2) Programme for Stage 1:**

According to the new education reform, grades one to grade four of the basic education (Stage 1) are taught by female teachers. Thus, the BA in education programme for Stage 1

which started in 1998/99 accepts just female students to enrol into this programme.

Teachers are trained for three areas of specialisation in this programme. These are as follows:

- Arabic Language, Islamic Education and Social Studies;
- Sciences and Mathematics;
- English Language.

This programme is hosted in the two female colleges (Rustaq and Ibri) and two coeducational colleges (Sur and Salalah).

### **3) Diploma of education programme**

This programme started in the academic year 1997/98 and it aims at the professional training of non-educational BA and BSc. holders from the SQU and other universities who wish to join the profession of teaching. This programme provides another source of Omani teachers in preparatory and secondary schools in the previous system and in the Stage Two of basic education in the reformed system. The following specialisations are offered in this programme:

- Islamic Studies;
- Arabic Language;
- Science;
- Mathematics;
- Social Studies.

The length of this programme is one academic year (two semesters) delivering 30 credit hours distributed as follows:

Foundations of Education	5 credit hrs	16.7%
Psychology	7 credit hrs.	23.3%
Methodology	7 credit hrs.	23.3%
Practicum	9 credit hrs.	30%
Elective course	2 credit hrs.	6.7%



#### **4) Other programmes**

The Colleges of Education also offer programmes and courses to keep pace with and respond positively to the requirements of the comprehensive development plans of the country. As Al Busaidi and Bashir (1997) report future planning and action of the general educational reform will be required for designing of future teacher education programmes.

The following are examples for these programmes:

- professional upgrading of the graduates of the 2-year Intermediate Teachers Training Colleges to BA degree level;
- development and delivery of various in-service courses for the teachers and other educationists; and
- organising seminars and workshops to enhance community development.

The Colleges' programmes are based on the competency approach. Thus, it is important to mention what have been addressed to be the major competencies in these programmes.

#### **2:3:1:3 Competency-based Approach**

College programmes are based on a competency-based approach to teacher education. Five major areas of competencies have been identified to agree with the envisaged role of the teacher. Student teachers are required to master these competencies. These competencies are as follows (Ministry of Higher Education, 1996):

- 1) **Subject specialisation competencies:** the student teachers are required to master the content of the syllabus that they are going to teach as well as the content of their field of specialisation.
- 2) **Professional competencies:** the student teachers are expected to acquire the skills that enable them to enact their role as teachers such as: teaching and learning strategies,

management of teaching process, evaluation and assessment, and competencies related to practical activities and educational technology.

- 3) **Cultural competencies:** competencies which enable student teachers to build up their hobbies and interests, and those that enable them to understand, analyse, broaden their knowledge and be aware of the national and religious issues.
- 4) **Continuing professional development competencies:** competencies that ensure continuing education and on-going development both professionally and in the area of specialisation.
- 5) **Community development competencies:** these competencies consolidate the social bonds between the student teachers and their society and enable them to play effective roles in the development of the society and the resolution of its problems and issues.

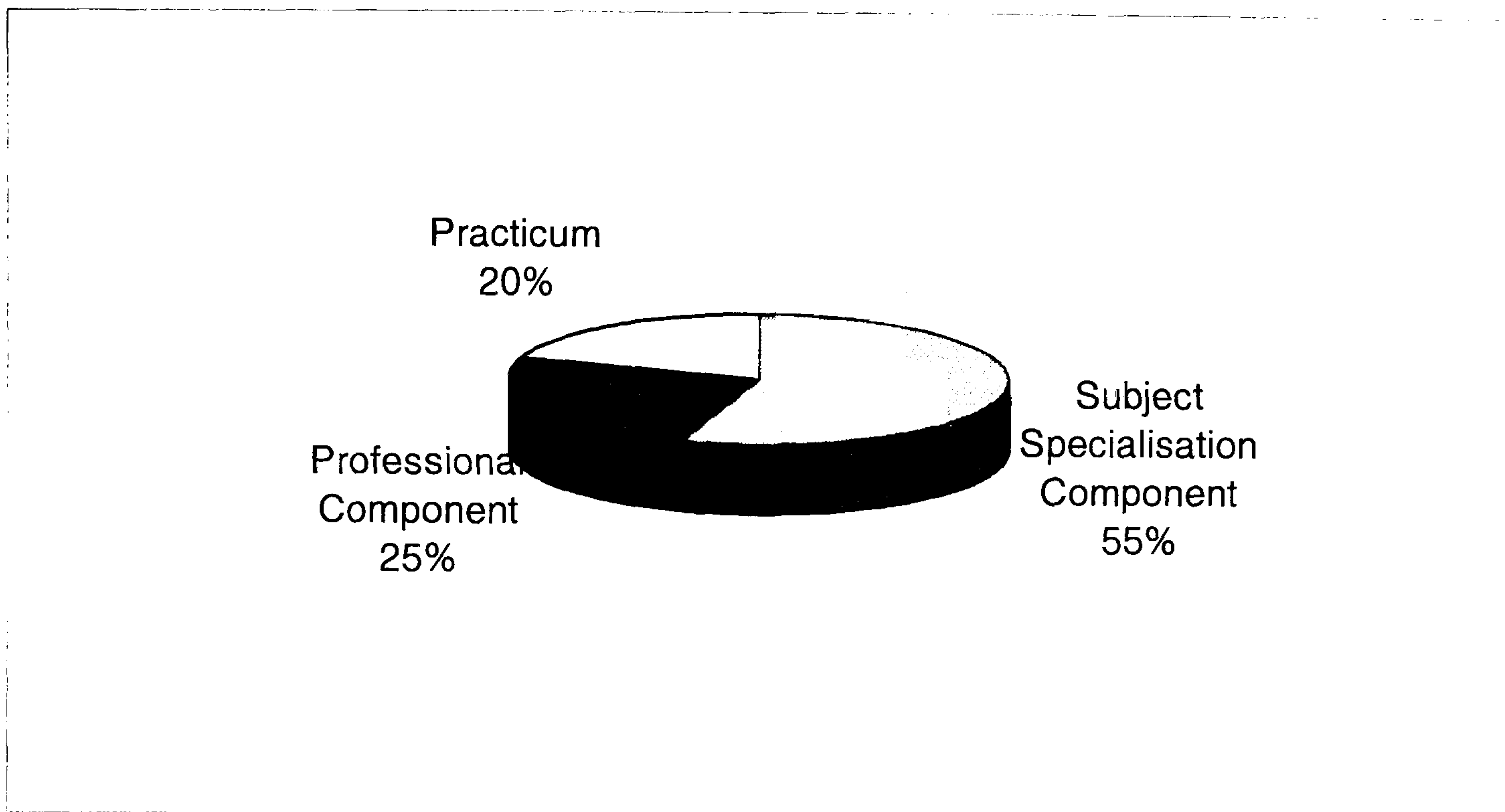
In summary, the aim of college programmes is to develop student teachers' skills and competencies, which help them to do their jobs effectively. To do so, these competencies are translated into objectives and then courses have been designed. Thus, it is crucial to address the components of college programmes.

### **2:3:1:4 Components of BA Programmes for Preparatory and Secondary Education**

Each programme of BA in education programmes for preparatory and secondary education and the second stage of the basic education has 132 credit hours to be delivered in 4 years. The academic year is made up of 2 semesters of 18 weeks each, (15 weeks for actual teaching and 3 weeks for examinations). The courses of each BA are classified into three main components. These are as follows:

- 1) **Professional and Educational Component:** this component is a total of 33 credit hours (25%) and it consists of educational courses (Curriculum and Methodologies, Educational Foundations, and Psychology) and cultural courses.

- 2) **Subject Specialisation Component:** this component is a total of 73 credit hours (55%) and it includes subject matter courses.
- 3) **Practicum Component (Teaching Practice):** this component is a total of 26 credit hours (20%). Figure (2:4) gives an overview of these components.



**Figure 2:4 the distribution of credit hours for Preparatory and Secondary Education programme**

Thus, the Colleges of Education address all aspect of teacher training. In addition, to implement the courses, a number of programme outlines and course description booklets were produced which are subject to constant review and development. The colleges provide a range of resources for teacher education. Learning resources centres have been established in all colleges offering multimedia resources for tutors and student teachers.

Due to the importance of the Pedagogical Courses and Practicum components for this study, special attention needs to be paid to a discussion of these components. Thus, the following sections address the pedagogical courses and practicum components of science teacher programme at the Colleges of Education.



## 1) Pedagogical Courses of the Science Teacher Programme

The student science teachers are required to complete pedagogical courses as an important part of the Colleges of Education' programmes. Table 2:4 illustrates the required pedagogical courses at science teacher programme in the Colleges.

**Table 2-4 Required Pedagogical Courses at the Omani Colleges of Education**

n.	Title of the Courses	Credit Hours
1	Education Foundation	3
2	Research Foundation and Statistics	3
3	Educational Psychology	3
4	Educational Evaluation and Psychological Assessment	3
5	Curriculum	2
6	Educational Technology	3
7	School Management	2
8	Comparative Educational Systems	3
9	Development Psychology	3
10	Science Teaching Methodologies	3
11	Elective Course in Education	2

Source: Ministry of Higher Education (1996)

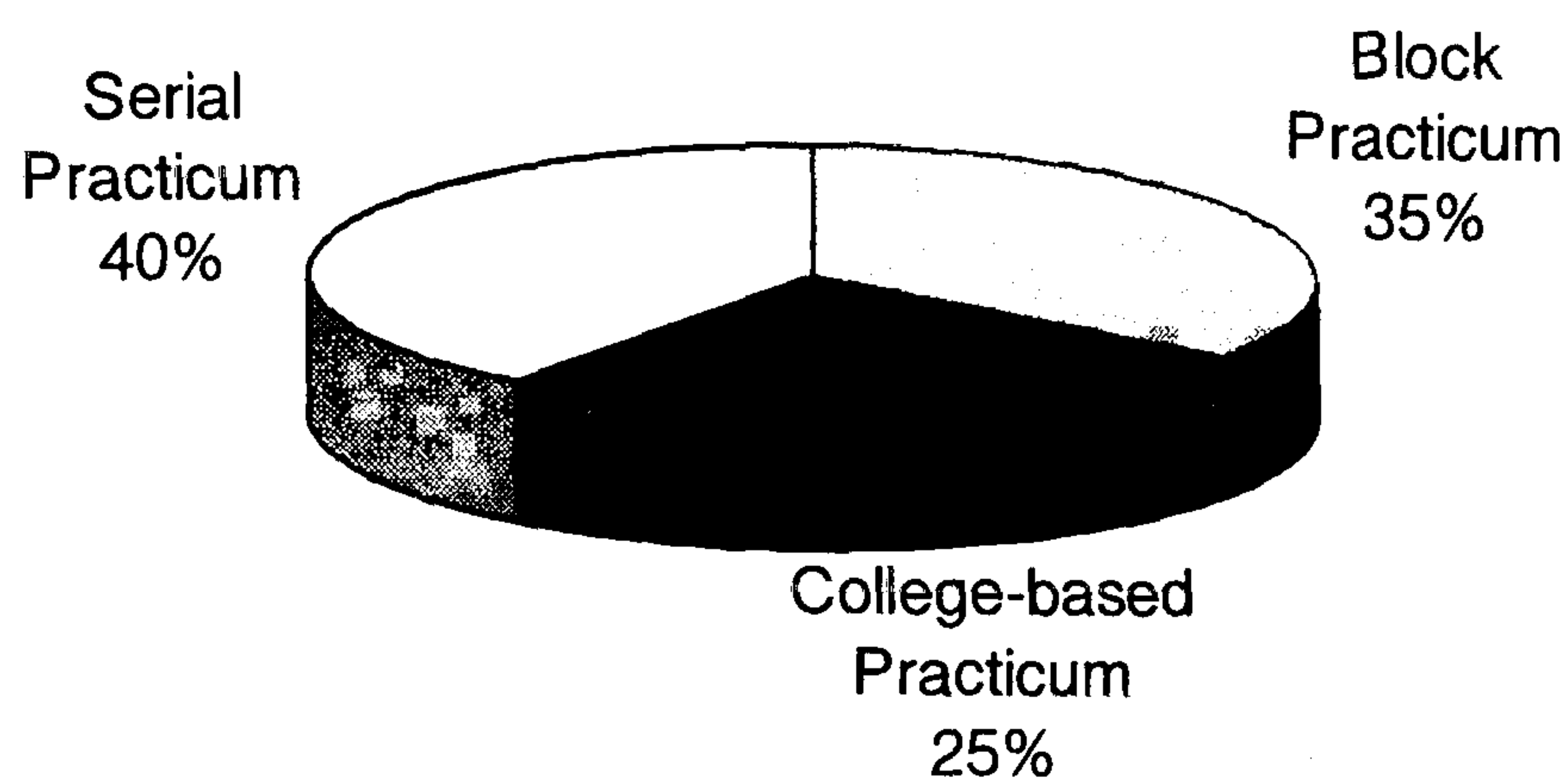
## 2) Practicum (Teaching Practice)

Teaching practice is one of the basic components of science teacher programmes at the Colleges of Education. The Colleges of Education consider the following as the most important principles of practicum (Al Busaidi, & Bashir, 1997 & Ministry of Higher Education, 1996):

- increasing the number of practicum hours and starting it at an early stage; in the first semester of the second year;
- emphasising school-based training which ensures a minimum number of hours for students to practise teaching in a school as part of practicum programme;
- developing college-based practicum with the aim of acquainting students with concepts of the basic competencies of education necessary for their future task. This is to be implemented through the organisation of workshops and other college-based activities.

The practicum includes three main components: college-based practicum; serial practicum and block practicum (Ministry of Higher Education, 1998). It is a total of 26 credit hours.

Figure (2:5) shows the distribution of the three main components of it.



**Figure 2:5 The distribution of the three main components of practicum for Preparatory and Secondary Education**

Six courses have been developed that include the three aspects of teaching practice: the college-based practicum, the serial practicum and the block practicum. Table (2:5) shows these courses and the credit hours of the components.

**Table 2:5 The practicum courses and the distribution of credit hours**

Semester	Course Title	Block Practicum	Serial Practicum	College-based Practicum	Total of Credit Hours
3	Practicum 1	—	2	1	3
4	Practicum 2	1	2	1	4
5	Practicum 3	1	2	1	4
6	Practicum 4	2	2	1	5
7	Practicum 5	2	2	1	5
8	Practicum 6	3	1	1	5
Total	6 courses	9 (35%)	11 (40%)	6 (25%)	26 (100%)

Source: Ministry of Higher Education (1996)

The college-based practicum is implemented in the colleges through planned workshops whereas the school-based practicum is implemented in schools. In the college-based components, student teachers are required to acquire seven basic competencies during semester three to eight. Table (2:6) gives an overview of the distribution of the targeted

seven skills over the semesters and the designated contact hours for each skills and each course of the practicum.

**Table 2-6 Distribution of the targeted seven skills over the semesters and the designated contact hours for each skill**

n	Competence	P. 1	p. 2	P. 3	P. 4	P. 5	P. 6	Total
		S. 3	S. 4	S. 5	S. 6	S. 7	S. 6	
1	Lesson Planning	14			14			28
2	Mastering of School Curriculum Content	20	16				14	50
3	Instructional Strategies	16			12			28
4	Teaching aid and Technology	12		14				26
5	Linguistic Skills	12				14		26
6	Assessment and Evaluation			24			10	24
7	Classroom Management		12			12		24
Number of hours in each semester		74	28	28	26	26	24	206

Adapted from Ministry of Higher Education (1998), P. = Practicum, S. = Semester

To implement these components, modules have been developed focusing on the objectives, content, the operations of implementation, activities, learning resources and assessment methods.

The school-based practicum consists of serial and block practicum. The serial practicum consists of two integrated components: micro teaching sessions and school-based training. In the micro teaching sessions, student teachers are trained on the basic teaching competencies whereas they apply these competencies in the school-based training.

The block teaching practice is organised to offer teaching opportunities in schools in one week in each of semesters 4 and 5, two weeks in each of semesters 6 and 7 and 3 weeks in semester 8 (Ministry of Higher Education, 1998b). In the school-based practicum, student teachers are required as school's teachers to teach whole classes in preparatory schools (pupils: 13 to 15 years old) and secondary schools (pupils: 16 to 18 years old).



In conclusion, the Colleges of Education offer several specialist programmes designed to meet the requirements of the structure of school education. However, the College's programmes for preparing teachers for the preparatory and secondary schools and the second stage of the basic education were implemented before the reform of general education started. Thus, these programmes should be reviewed to ensure those match the requirements of the reformed system.

### **2:3:2 In-Service Teacher Training**

In-service teacher education in Oman also has been trying to match the general education demands during the developmental stages of education in Oman. Hence, the urgent need of the Ministry of Education at the beginning of the Renaissance in 1970 determined the recruitment of some Omani teachers with only a simple knowledge of teaching (Al Hinai, 1997). These teachers had to be trained. Therefore, in-service teacher training in Oman started as early as 1972 (Isan, 1995).

In-service training in Oman can be categorised into three main phases. Phase one was in the 70s and early 80s, phase two was from mid 80s until 90s whereas phase three started with the current educational reform in Oman (1998). The first two phases were administrated by the Directorate of Teacher Preparation and Inspection.

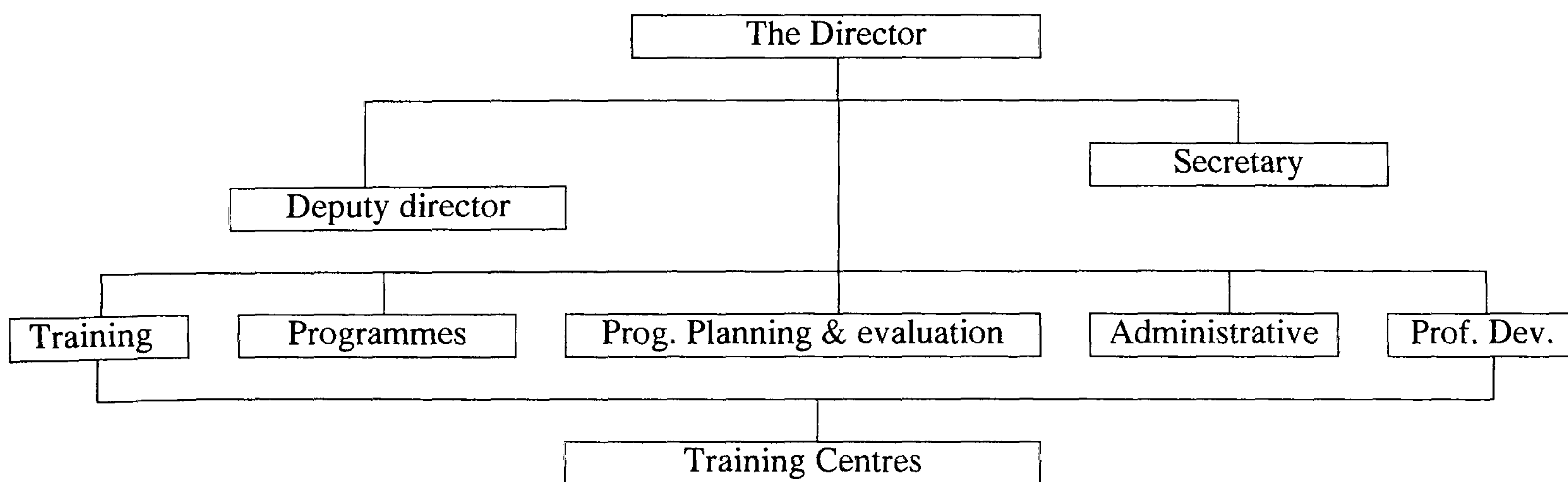
According to Abdullah (cited in Al Hinai, 1997) there were three main components in in-service training in phase one. These were: basic qualification; continuous training; and course and seminar's section. The first section was designed to carry out training courses for teachers who did not go through formal teacher education programmes. The second section was designed to update teachers' knowledge about the new methodology in education. The third section was meant to provide specialised courses in leadership for proposed school headteachers and inspectors.

In phase two, the Ministry of Higher Education continued training teachers in those components with especial emphasis on the demand of the Ministry at that time. For example, upgrading the qualifications of TTI graduates to ITTC degree was an important role of the Ministry at the phase two (Isan, 1995).

Hence, throughout the developments in Oman's educational system, from 1970 to 1995, in-service training had been developing to sustain the needs of the Ministry of Education.

In phase three, the features of the reform mentioned earlier require retraining of the teachers especially science, mathematics and English teachers. As the Ministry of Education (1995) reports that the reform requires redefinition of in-service teacher education to include the requalification and orientation of teachers for change and reform in the new education system.

Thus, the Ministry of Education created a new department for training its administrative staff and teachers called the Department of Training and Professional Development (DTPD), which is responsible for this phase, the current in-service teacher training. In addition, training centres in all the educational regions were established. See Figure (2:6).



**Figure 2:6 the Department of Training and Professional Development (DTPD).**

Al Hinai (1997) argues that the DTPD has a huge responsibility to train and develop the human resources who are involved in the educational reform. It should play an important role in fulfilling the following needs:

- train teachers and other technical staff to play their roles in the educational reform effectively;
- train the key education staff: headteachers, assistant headteachers and senior teachers;
- train supervisors, learning resource centres' staff and other senior administrative and technical personnel of both the central and regional levels;
- upgrade of the qualification of ITTC graduates to the university degree standard. This will be done in cooperation with the Colleges of Education;
- provide chances for postgraduate studies as diplomas, MA and PhD degrees for qualified members of staff involved in the implementation of the reform of education.

As improving teaching of science is one of the most important aspects of the educational reform, the teachers who teach this subject and the staff who are involved in the basic education are required to attend in-service training courses (Ministry of Education, 1995).

These courses provide at least a general understanding of the objectives and nature of the new science curricula. The focus of training science teachers includes the following:

- the philosophy of the new science curricula;
- the nature and format of the new teachers' Curriculum Guide;
- suggested methods for teaching science;
- the use of science equipment as a strong component in the programme;
- the use of the teachers' curriculum guide in science as a source of assignments rather than a student textbook;
- the use of the learning resource centre and other technologies;
- the role of teacher supervision;



- methods of day-to-day assessment of pupils and methods of overall evaluation.

Thus, in-service training has been serving the needs of the Ministry of Education during all the stages of its development. In the latest phase, DTPD is making a great effort to train teachers to work effectively in the reformed system.

**CHAPTER THREE:  
LITERATURE REVIEW**

# CHAPTER THREE: LITERATURE REVIEW

## 3:1 Introduction

Evaluation of teacher preparation programmes can be categorised as: **a) the components of the teacher preparation programmes** (Al Salmi, 1996; Chapman, 1990; Fraser, 1998 & Schmidinger, 1996) and **b) the teacher' skills and competencies** (Al Barwani & Ibrahim, 1997; Al Hethli, 1995; Al Salmi, 1996; Barker & Grayson, 1994; Bennett, 1988; Frame, 1990; Mifsud, 1996; & San, 1999); and **c) the needs and demands of the schools** (Manouchehri, 1997; Strawderman & Indsey, 1995 & Webber, 1996).

The literature review of this study covers all the three categories. In addition, special attention is paid to definitions of programme evaluation, the importance and purposes of evaluating teacher preparation programmes, the frameworks of programme evaluation and the problem-solving method as a strategy of teaching/learning science.

## 3:2 The Definitions of Programme Evaluation

As this research is an evaluative study, it is important to consider the nature of programme evaluation or evaluation research. According to Patton (cited in Mitzel, 1982a) programme evaluation is

*the systematic collection of information about the activities and outcomes of actual programs in order, for interested persons to make judgements about specific aspects of what the program is doing and affecting (p.595).*

In Galluzzo and Craig's view (1990), evaluation is

*a data collection process wherein the focus is on making decisions about the degree to which education programs, projects, or materials are valuable to the participants they are intended to serve and the system in which evaluation operates (p. 599).*



Evaluation is also addressed by Hitchcock and Hughes (1995) as a “*systematic study of a particular programme of a set of events covering a given period of time*” (p.34).

Beeby (cited in Wolf, 1990) considers evaluation as “*the systematic collection and interpretation of evidence, leading, as part of the process, to a judgement of value with a view action*” (p. 8). According to Wolf (1990), there are four key elements in this definition. They are as follows:

- 1) The use of the term *systematic* implies that the information needed will be defined with some degree of exactness. This is achieved by the systematic gathering and acquisition of information through observational procedures, questionnaires and interviews. The important point is that whatever sort of information is collected, it should be acquired in a systematic way.
- 2) *Interpretation of evidence* introduces a critical consideration that is sometimes overlooked in evaluation. Any evaluation is constituted from collection of evidence and interpretation of data gathered. Thus, information gathered in connection with evaluation of an educational programme must be interpreted with great care.
- 3) *Judgement of value* takes evaluation far beyond the level of mere description of what is happening in an educational enterprise. It puts an evaluator in place for conducting the evaluation in a way that not only permits, but also requires, judgements about the worth of an educational endeavour. Thus, evaluation involves gathering information about how an educational programme is succeeding in reaching its goals, interpreting this information and judging the goals themselves. There are two types of judgements: the first is the judgement of value of the programme, curriculum, or institution being evaluated, the second is the decision on future policy and action.
- 4) The last element is “*with a view to action*”. Evaluation is usually undertaken for the sake of improvement and future action. It is intended to lead to better policies and practices in education.

Systematic evaluation is thus a formal process. It involves an evaluation of quality or the determination of worth and merit of educational phenomena (Popham, 1988). The educational phenomena evaluated can include many things, such as the goals to which educational efforts are addressed, the effectiveness of a new teaching strategy on the students' achievement, or the outcomes of teacher education programmes.

Evaluation is similar to any other research in the sense of being a systematic inquiry of an issue and needs to be conducted through methods of investigation (Hitchcock & Hughes, 1995).

There are three activities related to evaluation: measurement, research and learner appraisal (Wolf, 1990). These share some similarities with evaluation. The following is a brief discussion of these activities.

### **3:2:1 Measurement and Evaluation:**

According to Choppin (1990) and Wolf (1990), measurement is the act or process of measuring. In education, it is essentially assigning a numerical quantity of educational interests such as attitudes toward various phenomena, problem solving and level of intelligence. Tests are typically used to measure educational interests. So, it is basically an *amoral process* in that there is no value placed on what is being measured.

On the other hand in evaluation, according to Wolf (1990), quite the opposite is the case. The major attributes studied are chosen precisely because they represent educational values. Hence, while evaluation and measurement specialists often engage in similar acts, such as systematically gathering information about learner performance, there is a

fundamental difference between the two in the value that is placed on what is being measured.

A second important distinction between evaluation and measurement inheres in the object of attention of each. Wolf (1990) argues that measurement in education is undertaken for the purpose of making comparisons between individuals with regard to some *characteristics*. This might be accomplished by administering the same comprehension test to the learners and seeing how many questions each has answered correctly. On the other hand, in evaluation it is often neither necessary nor even desirable to make such comparisons between learners. The interest here is the effectiveness of a programme. Thus, the evaluation and measurement are typically directed towards different ends; evaluation toward describing effects of treatments; measurement toward description and comparison of individuals. In evaluation, it is not necessary that different learners respond to the same questions.

### **3:2:2 Learner Appraisal**

According to Wolf (1990), learner appraisal is meant to evaluate the proficiencies of learners for the purpose of diagnoses, classification, marking and grading. In this sense it is not external like evaluation. Rather it is usually carried out by those people who are concerned with teaching and learning, such as teachers or inspectors. This is the main distinctive feature that distinguishes it from other forms of evaluation. Evaluation in this context is not done for the purpose of evaluating the effectiveness of a given programme *per se*, but the information obtained from the evaluation process is used to evaluate learners' mastery of certain aspects of the programme. The results of such programme evaluation may shed light on its effectiveness even though this might not be the direct purpose.



Appraisal might be important to the development of an organisation and its staff. According to Cyril and Poster (1993), appraisal is a means of promoting, through the use of certain techniques and procedures, the organisation's ability to accomplish its mission of maintaining or improving what it provides whilst at the same time seeking to maintain or enhance staff satisfaction and development. In this context, Montgomery (1999) argues that the most important purpose to which appraisal may be put is professional development.

### **3:2:3 Evaluation and Research**

Although evaluation and research share a number of common characteristics, there are some notable differences. Wolf (1990) considers the aims of research as producing new knowledge that may have no particular link to a decision, whereas evaluation is deliberately undertaken as a guide to action. Another difference between evaluation and research lies in the generalisation of results that each of them produces. In research, the study is designed and conducted in such a way as to ensure results that are as generalisable as possible while the resulting evaluative information has high local relevance for a particular programme. This means that evaluators direct their efforts toward verifying the effectiveness of the programme.

### **3:3 The Frameworks of Programme Evaluation**

According to Galluzzo and Craig (1990) the term 'model' is used

*to identify a variety of practices, philosophical stances toward evaluating practice, data-gathering technique, or even a graphic representation of an evaluation plan (p. 600).*

A systematic evaluation model is useful in any evaluative study where it provides a fundamental stance to help the evaluator to decide the method of data collection, what

research procedures will be utilised and from whom the data will be gathered. For the purpose of this research, such a model was considered in chapter one.

The importance of studying evaluation models is shown in a number of ways (Alkin & Ellett, 1990). For instance, understanding the various evaluation models gives insights and a framework for carrying out evaluations in a justifiable way. They provide consistent strategies for performing evaluations and present a range of validated possibilities for conducting evaluation.

To establish an evaluation model, reviewing different sources and models is important. For instance, Webbstock (1999) suggests five potential sources to establish criteria or models for assessment of teaching quality. These are:

- 1) Theory of teaching and learning.
- 2) Finding of empirical studies on effectiveness in teaching and learning.
- 3) Context-specific requirements.
- 4) Experience.
- 5) Actual examples.

Thus, the following is a discussion of some evaluation models of teacher education programmes.

There is more than one way to conduct a defensible educational evaluation (Popham, 1988). Therefore, there are different evaluation strategies and models for different educational situations.

Mitzel (1982a), for example, describes four models for evaluation of teacher education programmes: 1) experimental model, 2) eclectic approach, 3) descriptive model and 4) cost-benefit analysis model. This classification of these models is based on methodological orientations.

*Experimental approach* is conducted “to establish cause and effect relationships between dependent (output) and independent (input) variables” (p. 599). In the *eclectic approach*, the purpose is to question “the value of large-scale experimental studies of intervention programs” (p. 599). This approach takes an eclectic position by drawing upon experimental designs that make possible casual statements along with methods that describe the process of programme implementation as well as the contextual variable affecting the programme. In this model, an evaluation design can search for multiple causality or generate plausible explanations that approximate reality. The central concern of this approach is to overemphasise upon achievement as the single most important outcome.

In the *descriptive model*, meaningful data are gathered through “in-depth descriptions of the programme in context and through the personal testimony of participants” (p. 599). A *cost-benefit approach* is designed to “determine how to choose between anticipated costs and anticipated benefits among alternatives” (p. 601). Table 3:1 indicates these four methodological models, gives an overview of them, and compares their characteristics on ten dimensions.



**Table 3-1 Four methodological approaches in programme evaluation**

	<b>Experimental Model</b>	<b>Eclectic Model</b>	<b>Descriptive Model</b>	<b>Benefit-Cost Model</b>
<i>Philosophical base</i>	Positivist	Modified positivist to pragmatic	Phenomenological	Logical/analytic
<i>Disciplinary base</i>	Psychology	Psychology; sociology; political science	Sociology; anthropology	Logical/analytic
<i>Focus of methodology</i>	Identify causal link	Augment search for causal links with process and contextual data	Describe programme holistically and from perspective of the participants	Judge worth of programme in terms of cost and benefits
<i>Methodology</i>	Experimental & quasi-experimental designs	Quasi-experimental designs; case studies; descriptions	Ethnography; case studies; participant observation; triangulation	Benefit-cost analysis
<i>Variables</i>	Predetermined as input-output	Predetermined plus emerging	Emerging in course of evaluation	Predetermined
<i>Control of comparison group</i>	Yes	Where possible	Not necessary	Yes
<i>Participants' role in carrying out evaluation</i>	None	None to interactive	Varies (may react to field notes)	None
<i>Evaluator's role</i>	Independent of programme	Cooperative	Interactive	Independent of programme
<i>Political pressures (internal-external)</i>	Controlled in design; or ignored	Accommodated	Describe	Ignore
<i>Focus of evaluation report</i>	Render "go/no go" decision	Interpret and recommend for programme improvement	Present holistic portrayal of programme in process	Render judgement

Adapted from Mitzel (1982a)

Alkin and Ellett (1990) also identify two types of models: prescriptive and descriptive. A prescriptive model is a set of rules, prescriptions, and guiding frameworks which specify what a proper evaluation is and how evaluation should be carried out. A descriptive model, on the other hand, is a set of statements and generalisations, which describe, predict or explain evaluation activities.

In relation to the models of evaluation of pre-service teacher education programmes, Galluzzo and Craig (1990) reviewed the literature. They classified the models into

*objectives-based evaluation* models and *decision-facilitation* models. The objectives-based evaluation models are divided into formative-summative; goal-free; and countenance model. The most widely known decision-facilitation model is the Stufflebeam's **CIPP** (Context, Input, Process, and Product) model. The following is a discussion about these models.

### **3:3:1 Formative-Summative Approach**

According to Galluzzo and Craig (1990), Scriven made significant contributions to the evaluation literature. He distinguished between the role of formative and summative's evaluator. In formative evaluation, *the evaluator is working to improve a project, program, or set of materials still under development* (p. 600) whereas, in summative evaluation, the evaluator is seeking to assess the merit of a completed programme, project, or set of materials.

### **3:3:2 Goal-Free Model**

The goal-free approach focuses on the outcomes of a programme, intended as well as unanticipated (Popham, 1988). In this approach, Galluzzo and Craig (1990) argue that the evaluator intentionally avoids any direct contact with the goals of the programme the planners might have stated. So, the evaluator is more free to seek any and all information that can be used to discuss the worth and merit of the programme. Furthermore, Popham (1988) indicates that the fundamental advantage of the goal-free model is that *it encourages the evaluator to be attentive to a wider range of program outcomes* (p.30). This wider range of outcomes might not be collected by an evaluator who has been unduly influenced to look for project results consonant with project aims.

### 3:3:3 The Stake's Countenance Model (Galluzzo & Craig, 1990, & Popham, 1988):

The Stake's countenance model (Figure 3.1) emphasises two critical elements of evaluation: description and judgement. In this model, evaluations should reach descriptions of three phases of a given programme: 1) pre-existing conditions or "antecedents", 2) the processes of the programme or "transactions" and 3) the effects or "outcomes". Each phase is divided into a description matrix and judgement matrix. The description matrix includes intents and observations. The judgement matrix comprised of standards and judgements (Galluzzo & Craig, 1990). In addition, this model assumes the existence of a rationale guiding the design of the evaluation of educational programme (Popham, 1988). Thus, the rationale is an important aspect of this model.

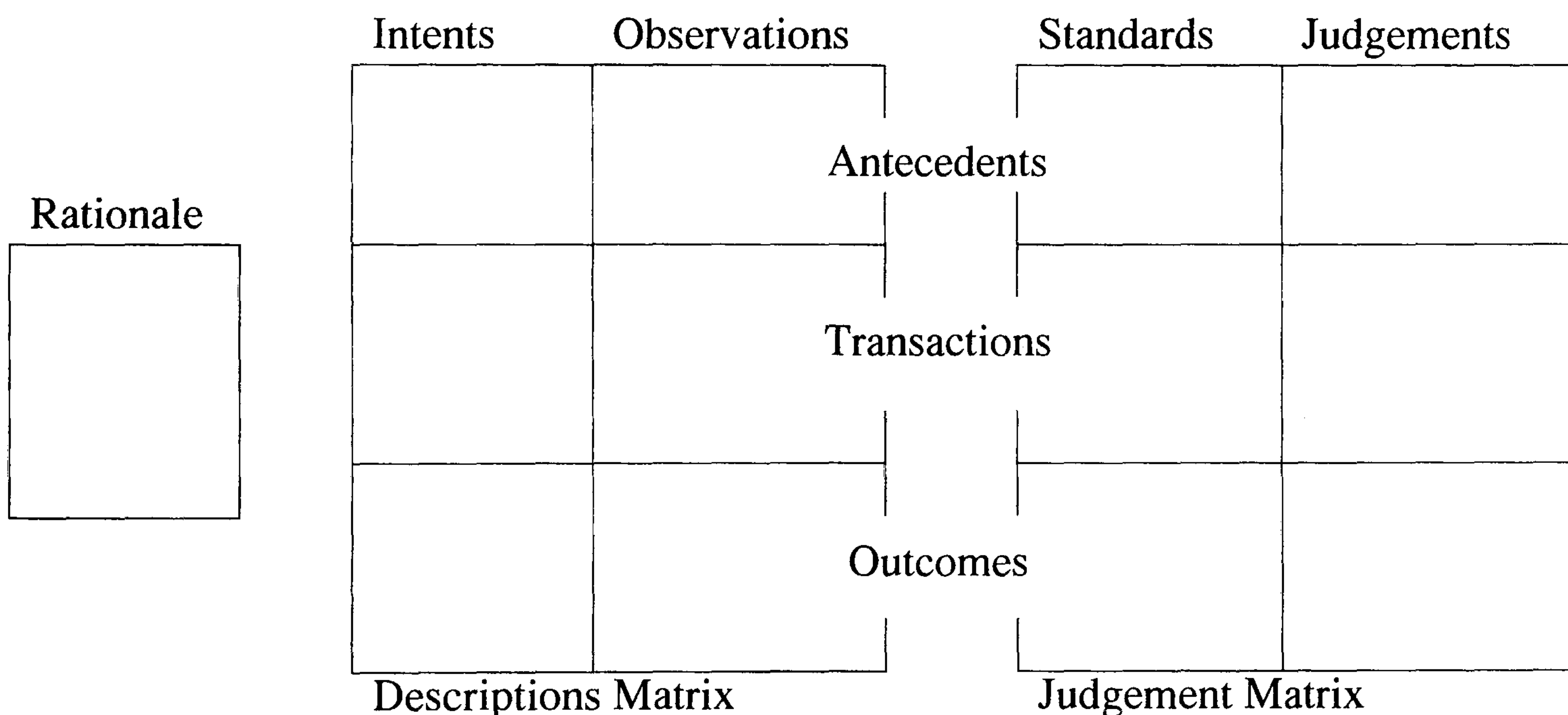


Figure 3-1 Stake's Countenance Model, cited in (Galluzzo & Craig, 1990)

### 3:3:4 The Stufflebeam's CIPP (Context, Input, Process and Product) Model

The Stufflebeam's CIPP model is a decision-facilitation model. Its aim is to serve educational decision-makers (Galluzzo & Craig, 1990). It was developed in the late 1960s. This approach is based on the view that *"the most important purpose of evaluation is not to*



*prove but to improve*” (Stufflebeam, 1983: p. 118). This approach sees evaluation as a tool to help make programmes work better for the people they are intended to serve.

The CIPP model is composed of four types of evaluation. These are a) Context evaluation, b) Input evaluation, c) Process evaluation, and d) Product evaluation (Stufflebeam, 1983).

It distinguishes four types of educational decisions:

- 1) Planning decisions to determine objectives.
- 2) Structuring decisions to design instructional procedures.
- 3) Implementing decisions to use, monitor, and improve these procedures.
- 4) Recycling decisions to judge and react to the outcomes produced by those procedures.

This model also distinguishes between evaluation for decision making, *formative evaluation* and evaluation for accountability, *summative evaluation*. Table 3:2 presents the relevance of four evaluation types to decision making and accountability.

**Table 3-2 The Stufflebeam’s CIPP model: the relevance of four evaluation types to decision making and accountability**

	Context	Input	Process	Product
Decision making ( <i>formative evaluation</i> )	Guidance for choice of objectives and assignment of priorities	Guidance for choice of program strategy	Guidance for implementation	Guidance for termination, continuation, modification, or installation
Accountability ( <i>summative evaluation</i> )	Record of objectives and bases for their choice along with a record of needs, opportunities, and problems	Record of chosen strategy and design and reasons for their choice over other alternatives	Record of actual process	Record of attainments and recycling decisions

Adapted from Stufflebeam (1983)

According to Popham (1988), the CIPP model provided the first full-blown framework to guide those evaluators who saw their mission chiefly as one of helping those who must make educational decisions. Mertens (1998) concluded that the CIPP model tries to

incorporate many aspects of the programme. Galluzzo & Craig (1990) summarise them as follows:

- a context evaluation provides a rationale for the identification of educational objectives. In the context evaluation of educational programmes, the evaluator identifies the target population, conducts needs assessments, and provides information for judging whether the objectives are responsive to the assessed needs;
- in input evaluation, the evaluator seeks to determine whether the programme has the resources to insure the successful completion of the programme. Evaluators work to identify strategies for implementation that resonate with the human, fiscal, logistical, and temporal resources available. Input evaluation should inform the decision makers of potential problem areas in implementation,
- a process evaluation is conducted once the programme has been established and is operating. It aims at locating any flaws in the procedures or process in the implementation of the programme. The role of the process evaluator is to identify aspects of the programme that might need adjustment;
- in product evaluation, the purpose is to collect data on the outcomes of the programme, to relate them to the contexts, inputs and processes, and to interpret their worth and merit. The evaluator here helps the programme planners decide whether the programme should be continued, revised, or terminated (pp. 601-602).

### **3:3:5 Competency-Based Approach**

Another model of evaluation that has been used to evaluate initial teacher training is known as a competency-based evaluation framework (Barton & Elliott, 1996 & Earley, 1996). According to Feiman-Nemser (1990) competency-based teacher education requires that teacher educators state explicitly the competencies students will acquire in their programme and the criteria by which they will be assessed.

To evaluate teacher competencies, it is essential to develop criteria. For example, Dwyer (1993) developed “Assessment Criteria” to evaluate beginning teachers. His approach involves four aspects. These are: 1) organising content knowledge for student learning; 2) creating an environment for student learning; 3) teaching for student learning; 4) teacher professionalism.

To conclude, although there are differences between these models in designing evaluation research, there are some common features associated with some of these approaches:

- models of programme evaluation are systematic in approach;
- sources are important to establish an evaluation model;
- rationales are important for programme evaluations;
- programme evaluation is about products and processes;
- programme evaluation and improvement are linked.

These points are considered in this research. For instance, a systematic approach is aimed at improving the science teacher programme by defining and making judgements on its effectiveness. In addition, this research is about output evaluation; i.e. the competencies of science teachers, and also processes evaluation; i.e. the effectiveness of the pedagogical courses and teaching practice.

### **3:4 The Importance and Purposes of the Research in Evaluating Teacher Preparation Programmes**

Evaluation research serves many purposes. Bullock and Scott (1992) state three reasons or purposes for carrying out an evaluation study. These are to a) provide accountability; b) provide strategies for development c) understand the process more clearly. Galluzzo and



Craig (1990) add another purpose for conducting evaluation, knowledge production. This purpose contributes to the knowledge of teacher education.

Worthen *et al.* (cited in Mertens, 1998) state a number of purposes for evaluation:

- to decide whether to continue, modify, expand, or terminate an existing programme;
- to determine whether to adopt a new programme or product;
- to explore the extent to which the operation of an attempt is similar to its design;
- to evaluate the overall value of a programme and its relative value and cost compared with that of competing programmes;
- to help sponsors, clients and stakeholders to determine whether identified problems are being solved (p. 233).

It is concluded that the most important purpose of evaluation is to improve the quality of the programme under study. According to Jong and Brinkman (1999) new research should play a major role in each of the following steps necessary for improving teacher education:

- description and analysis of the core difficulties and problems in the education of teachers;
- identification and clarification of possible origins and causes of the difficulties;
- development and implementation of carefully research-based screened education strategies and course curricula;
- serving the new pre-determined teaching and learning objectives;
- continual and systematic evaluation of new teacher training approaches and strategies and the extent to which they achieve their goals (p. 8).

Thus, research plays a major role in changing, developing and improving the quality of teacher education programmes. Researchers tend to emphasise either structural or conceptual issues or a blend of both (Feiman-Nemser, 1990).

In terms of the structural changes, many teacher education reforms, for instance, call for adding an extra year(s), increasing the amount of teaching practice, limiting the number of credit hours in education, creating alternative routes to teaching by providing on-the-job training for liberal arts graduates (Feiman-Nemser, 1990).

Regarding the conceptual changes, these are some examples: helping teachers to examine their preconceptions about teaching and learning; to learn about transforming subject-matter knowledge for purposes of teaching; and to develop a commitment to teach all pupils (Feiman-Nemser, 1990).

In relation to developing science teacher education programmes, many universities have responded to the challenge of improving their preparation of teachers in science and mathematics (McDevitt, *et al.*, 1999). For instance, a recent conference featured innovative programmes for preparing elementary teachers (Gardner & Cochran, cited in McDevitt, *et al.*, 1999). The characteristics of effective programmes proposed by participants focused on relevance of science and mathematics for pupils' everyday lives. They also focused on the selection of content that builds on pupils' understandings; inquiry modes of instruction; promotion of access to science, mathematics, and technology for all pupils; collaborative learning environments; early, sustained and reflective teaching practice; and so on.

The findings of Kahle and Boome's study (2000) have several implications for teacher education and policies. For example, this study suggests the following:

- the need to connect pre-service science teacher education more closely with in-service professional development, as well as the importance for pre-service education to set the expectation for continued learning;
- results concerning the need for problem-solving materials and the need to address the learning of diverse groups of pupils suggest that these topics should be included in pre-service teacher education programmes;
- alignment between curriculum and tests needs to be explicit and explicated in pre-service education;
- educators and policy makers need to be certain that the integral components, instruction, curriculum and tests of the science education reform, are aligned, and links across these components need to be made in pre-service education;
- pre-service teachers need access to, and practice with, an inquiry-based curriculum.

In trying to develop a vision for teacher preparation programme, Sultana (1995), at the University of Malta, presents a value-based approach to the development of initial teacher preparation programmes. This approach is based on a vision of values shared by staff and students and addresses three major elements. These are: 1) the qualities of “good teacher”, as articulated during different staff seminars and debates, 2) value and 3) course implications. This approach can help teacher educators in developing and clarifying objectives as they set out to create coherent programmes that provide a sense of mission based on identifiable values and principles.

Based on what has been mentioned above, the improvement of any teacher education programme ought to be guided and accomplished by the utilisation of the results of research. As Anderson (2000) states: science education research could contribute much to develop teacher programmes that promote the valued qualities of practice.



### **3:5 Teacher Preparation Programmes and the Needs and reforms of Schools:**

Teacher preparation programmes and the needs of schools should be strongly linked (Strawderman & Indsey, 1995; Manouchehri, 1997 & Webber, 1996). Creemers (1994) says, “*teacher behaviour in the classroom is positively related to student achievement*” (p. 194). Mitzel (1982b) also states that

*The teacher is the point of contact between the educational system and the pupil: the impact of any educational program or innovation on the pupil operates through the pupil’s teachers* (p. 1894).

These statements clearly imply that the school’ effectiveness depends directly on the effectiveness of its teachers. Creemers (1997) argues that educational outcomes, both cognitive and affective, are most strongly influenced by classroom effectiveness factors. He categorises these factors into: “*the curriculum, the grouping procedures which are applied and the behaviour of the teacher*” (p.22). One of these factors is the teacher and the other two factors are directly related to the teacher. The effects of other factors will be reinforced when teachers have effective skills and abilities. This in turn will help them to use good materials and to select grouping procedures that fit with the curricular demands.

Calderhead and Shorrock (1997) argue that the quality of initial teacher training programmes should be improved to meet the increasing quality demands of the schools and teachers. They say that this has raised questions about how teachers are best trained for their work in the schools. Goodlad (cited in Fullan, 1991) proposed sets of expectations for teacher education programmes:

*that they will provide teachers with the necessary intellectual tools and subject-matter knowledge, that they will insure that teachers have a solid initial grounding in pedagogy and that they develop in teachers the beginning levels of the knowledge and skills required to run our schools* (P. 299).

Thus, collaboration between teacher training institutions and schools is necessary. As San (1999) says this collaboration will help to improve initial training programmes, and student teachers will be able to meet changes in the schools and the society when they become teachers.

In the United States, the reform of science education in the schools demands that changes occur in the culture in which science teaching and learning take place. The reform requires that school administrators, parents, scientists, university educators, and people from business, industry, and state and federal agencies must all be involved in the change process. Most strategies proposed for implementing this new vision of science education begin with teachers (Coble & Koballa, Jr, 1996). Coble and Koballa, Jr (Ibid.) argue that teachers are directly responsible for implementing the changes associated with this new reform of science education in classroom. They demand that science teacher education should play a major role in preparing effective teachers in order to enact the changes that accompany this new vision of science education.

In Australia, the emphasis of school curricula is being refocused to promote the development of learning outcomes that articulate with what are perceived to be *key competencies* (e.g. solving problems; working with others; planning and organising activities). Teachers are increasingly being required to develop teaching and learning experiences that respond to this change (Australian Educational Council and Ministers for Vocational Educational Training, cited in Brookler and Service, 1999). In this new system, as Brooker and Service (1999) argue: subject matter is being seen as a medium for learning rather than content to be mastered. Thus, teachers are increasingly being required to develop their teaching methods through experiential learning thus pupils will take greater responsibility for their learning. This means that teachers should have the skills and



competencies, which help them to face the challenges of incorporating a broader range of pedagogical processes into their teaching to meet the changing emphasis in the curricula.

Strawderman and Lindsey (1995) examined the literature on teacher training reform in comparison with general school and special education reform. They found that the former is sparse and the latter is prolific. They argue that this condition implies that Higher Education Institutions are not preparing future teachers to meet the demands of today's schools. Strawderman and Lindsey (1995) found three prominent trends in pre-service teacher preparation reform in terms of a new or different relationship between general and special education programmes. These are: 1) infusion of some disciplines and activities into existing programmes; 2) restructuring of organisational systems; and 3) restructuring of coursework and/or course requirements for certification. They conclude that all these three reform ideas have promise for providing prospective teachers with more comprehensive skills to be effective with diverse student populations and to collaborate more effectively. They also provide a base for healing the rift between special and regular school education and teacher preparation.

Thus, if the school curriculum changes, the need for competent and skilled teachers becomes more crucial. Teachers will need better preparation in their pre-service training and professional development as in-service training. As Manouchehri (1997) argues: if the recommendations of the school curriculum reform focus attention on teaching, they require that teacher education programmes play an integral role in familiarising teachers with current recommendations and preparing them with the professional knowledge base for realising those visions. Manouchehri (Ibid.) examined the research on teacher education and ended up with four reform areas in educating teachers: 1) teachers' beliefs, 2) content knowledge, 3) pedagogical content knowledge, and 4) pedagogical reasoning.



1. *Teachers' beliefs*: due to the teachers' prior beliefs and experience, prospective teachers may not see the relevance of pedagogy courses to the process of learning to teach and they may not attend closely to experiences and information in these courses. Thus, teacher education programmes should help students discard some prior knowledge, beliefs and dispositions about subject and pedagogy they bring to the pre-service programme. They must challenge students' beliefs about the adequacy of their knowledge base for teaching and help them to make implicit beliefs about teaching, learning, subject matter and learning to teach explicitly. To achieve this, prospective teachers should have opportunities in collegiate courses to do the content of the subjects in ways different from their previous knowledge. They must examine, explore, analyse, construct models, collect and present data, present arguments and solve problems. The pre-service programmes must reflect the changes in emphasis and content of the reformed school curriculum. As a result of this, student teachers must challenge the adequacy of those beliefs and examine new ideas and integrate new information into their belief systems to be effective teachers in the reformed schools.
2. *Content Knowledge*: as the subject matter knowledge is the central focus of teacher education programmes, these programmes must pay higher attention to the subject knowledge of the prospective teachers. Prospective teachers must have the opportunity in their university coursework to strengthen their content knowledge while being exposed to the type of teaching consistent with the recommendations of the reform. Teacher preparation programmes must provide prospective teachers with an understanding of key facts, concepts, principles and definitions. This is in order to be able to define for pupils these facts and the accepted truths in a domain and explain the validity and worth of particular propositions as well as their relationships to other propositions. These programmes should also offer the opportunities to develop a substantive understanding of teachers' field in their own elementary and secondary schools. **More details about the subject-matter courses are addressed latter.**

3. *Pedagogical content knowledge*: Subject knowledge alone is insufficient. Teachers require knowledge of subject, supplemented with knowledge of pupils and of learning; knowledge of curriculum and school context; and knowledge of teaching (pedagogical Content Knowledge: PCK). Thus, pre-service teacher courses must make PCK a priority and these courses should strengthen teachers' PCK to be consistent with types of teaching recommended in the reformed schools. In addition, as the knowledge and experience of pupils' thinking has an important impact on classroom learning, teacher educators must provide extensive opportunities for student teachers to become familiar with models of pupils' thinking and cognitive processes. Development of the inquiry and constructive approaches where teachers must rely on their own questioning, observing and listening to pupils should become the goal of teacher education programmes (Manouchehri, 1997). Cooney (cited in Manouchehri, 1997) recommended that teacher education programmes should design *constructivist* learning environments. These recommendations are to: a) enable teachers to develop knowledge that permits the teaching from a constructive perspective; b) offer occasions for teachers to reflect on their own experience as learners; c) provide contexts in which teachers develop expertise in identifying and analysing the constraints they face in teaching and how they can deal with these constraints; and d) furnish context in which teachers gain experience in assessing a pupil's understanding.
4. *Pedagogical reasoning*: pedagogical reasoning is the process of transforming content knowledge into pedagogically powerful forms adaptive to particular groups of pupils. This transition is a major component of learning to teach and prospective teachers find it difficult to make the transition (Brown & Borko and Fieman-Nemser & Buchmann cited in Manouchehri, 1997). They recommended that teacher educators should take an active role in guiding prospective teachers' pedagogical reasoning by demonstrating teacher actions and decisions. They should focus on actual challenges addressed in the reformed curricula that teachers will face in the classroom to develop pedagogical



reasoning (Lanier & Little, cited in Manouchehri, 1997). These challenges must be addressed in the teacher preparation programmes.

As pedagogical skills and reasoning are important for prospective teachers, Joyce (1988) described a training system for educating teachers. This system combines four components: 1) the study of the theory and research of teaching skills; 2) demonstrations of the teaching skills; 3) simulated practice of the skills and 4) self-feedback on skill acquisition. Cruickshank and Metcalf (1990) argue that the use of simulation is an effective way to assist prospective teachers in developing skills in pedagogical reasoning and problem solving. The aim of these simulations is to provide the teacher with awareness and an opportunity to learn and practice adequate responses and strategies in problem context.

According to Manouchehri (1997) the use of simulations in teacher education programmes has at least two benefits. They accustom prospective teachers with the problems of real classroom settings and prepare them for what may be encountered later as they start to teach. In addition, due to the importance of technology on developing effective teachers' skills, Brooks and Kopp (1990) argue that technology-based simulations included in the teacher education programmes are very effective. This helps prospective teachers in providing them with actual situations that allow them to analyse teaching, suggest alternative teaching strategies and increase confidence in using different instructional materials.

In summary, it is clear that teacher preparation programmes, to be effective in educating prospective teachers, must go hand in hand with school reform. Any reform in the school system should correspond with a reform in the teacher education programmes. As Manouchehri (1997) states: simultaneous reform in teacher education must accompany efforts toward school reform, lest they become futile. Thus, if teachers are to choose the



visions offered by a reform, they must be convinced of their values and have exposure to a similar learning environment firsthand as learners.

### 3:6 Components of Teacher Preparation Programmes

Science teachers are required to learn a body of professional knowledge for teaching during their initial stage of teacher education (Mellado, 1998). This includes the following categories (as summarised by Peterson and Treagust (1998)):

- *subject matter knowledge;*
- *general pedagogical knowledge;*
- *curriculum knowledge;*
- *pedagogical content knowledge;*
- *knowledge of learning;*
- *knowledge of education context;*
- *knowledge of education ends, purposes and values (p. 216).*

Three major components in pre-service teacher education have been identified which can influence initial teacher socialisation (Zeichner & Gore, 1990):

1. general education that includes liberal and science courses or subject matter courses;
2. method and foundation courses or professional (pedagogical) courses;
3. field-based experiences or teaching practice that is usually carried out in elementary and secondary school classrooms.

In England and Wales, for example, the Initial Teacher Training (ITT) is based on the Standards for the Award of Qualified Teacher Status (QTS). These standards are built on the requirements of the Circular 4/98, which introduced the first ever national curriculum for ITT. The Circular represented a major step change in the expectations and requirements of new teachers (DfEE, 1998). This circular contains initial teacher preparation programmes' curricula. For example, in the training of secondary science teachers, the curriculum should be read alongside the standards for the Award of Qualified Teacher Status and the National Curriculum for the use of Information and Communication Technology (ICT) (DfEE, 1998). The curriculum introduces a standard basis for providers

of secondary science ITT in partnership schools, higher education institutions and elsewhere. The curriculum includes three components. These are as follows (DfEE, 1998):

*1) Pedagogical knowledge and understanding required by trainees to secure pupils' progress in science: This section sets out the pedagogical knowledge and understanding which, as part of all courses, trainees must be thought and be able to apply in order to secure pupils' progress in science. By the end of their course, trainees must demonstrate that they know, understand and can apply this knowledge when teaching science at key stage 2, 3 or 4 and, where appropriate post-16.*

*2) Effective teaching and assessment methods: This section sets out the teaching and assessment methods which, as part of all courses, all trainees must be thought and be able to use.*

*3) Trainees' knowledge and understanding of science: This section sets out the subject knowledge and understanding of science which trainees need to support effective teaching of science for 11-19 age-range (pp. 117-118).*

In addition, these components are not taught discretely. They are integrated when providers are designing science courses (DfEE, 1998). Similarly, in the context of delivering and assessing these components, *"providers should use the curriculum as the basis for devising secondary science courses which are coherent, intellectually stimulating and professionally challenging"* (p. 118).

In the United State of America, Coble and Koballa, Jr (1996) reviewed the literature of models used in science teacher preparation programmes and highlighted that these programmes also are combinations of science courses, pedagogical courses and field experience.

Pre-service training programmes in most Arab countries follow the same direction (Al Salmi, 1996). In Oman, for example, the programmes of the Colleges of Education which are based on competency-approach address these three aspects of training by the distribution of credit hours into 55% subject-matter courses, 25 % professional and cultural courses, and 20% teaching practice. Practicum is divided into: college-based workshops,



serial practicum and block practicum (Ministry of Higher Education, 1996). This is discussed further in chapter two.

Thus, the components of pre-service teacher training programmes are similar throughout the world. These are subject matter courses, pedagogical courses and teaching practice. The following sections are about these components.

### **3:6:1 Subject-Matter Courses**

*If anything is to be regarded as a specific preparation for teaching, priority must be given to a through grounding in something to teach (Peters, cited in Ball & McDiarmid, 1990, p. 437).*

Based on this statement, subject matter is thus a fundamental component of teacher knowledge. Ball & McDiarmid (1990) argue that the numerous tasks of teaching, such as selecting worthwhile learning activities, giving helpful explanation, asking productive questions, and evaluating pupils' learning, all depend on the teacher's understanding of what it is that pupils are to learn. They add that a conceptual mastery of subject matter and the capacity to be critical of knowledge itself can empower students to be effective actors in their environment.

They also argue that "*teachers' own subject matter knowledge influences their efforts to help pupils learn subject matter*" (p. 438) and ignorant or uniformed teachers can do much harm. For example, teachers who possess inaccurate information or conceive of knowledge in narrow ways, may pass on these ideas to their pupils. They may also fail to challenge pupils' misconceptions.

It is important for teachers to know about the subject matter they teach beyond the specific topics of their curriculum. As Shulman (1986) argues: teachers must not only be capable of

defining for students the accepted truths in a domain. They must also be able to explain why a particular proposition is deemed warranted, why it is worth knowing, and how it relates to other propositions (p. 438). Ball & McDiarmid (1990) add that this kind of knowledge encompasses a knowledge of the intellectual fabric and essence of the subject matter itself.

Ball & McDiarmid (1990) identify three outcomes of teachers' subject-matter learning. These are as follows:

**1) *Substantive knowledge of the subject:***

Although most subject matter fields are continually changing and growing, each field includes specific information, ideas, and topics. These can be subject to disagreement and different interpretation based on competing perspectives within the field. Components of a subject, and the terms used to classify it, differ from one subject to another. For example, knowledge of biology includes specific concepts, definitions, conventions and procedures (e.g. knowledge of organisms, their functions and relationships (respiration and photosynthesis), and the nomenclature that signifies systemic differences.

In the United States, Project 2061's *Science for All Americans* explicates several *big ideas* of science to be a core of science content knowledge of all teachers. These concern the physical settings, the living environment, the human organism and the technological world (Coble & Koballa, Jr, 1996). The depth of understanding of teachers of these elements depends on the teacher's chosen level of teaching.

**2) *Knowledge about the subject***

In addition to substantive knowledge, subject knowledge also includes "*a host of understandings about the subject*" (Ball & McDiarmid, 1990: p. 440). Examples are: the relative validity and centrality of different ideas or perspectives, the major disagreements within the field, how claims are justified and validated, and what doing and engaging in the discourse of the field entails.

### ***3) Dispositions (Attitudes) toward the subject***

Bybee (cited in Coble & Koballa, Jr, 1996) defines attitudes as “*dispositions to behave in certain ways and habits of mind that result in predictable actions*” (p. 464). Pupils develop dispositions towards subjects as a part of the subject matter learning. They acquire *tastes and distastes* for particular activities and topics. They also have propensities to pursue certain kinds of study and to avoid others (Ball & McDiarmid, 1990). So, pupils develop conceptions of themselves as good at specific subjects and not at others. Coble & Koballa, Jr, (1996) argue that because teachers of science are responsible for the additional development of their pupils, they must be knowledgeable about the types of attitudes they are expected to promote. Teachers also must recognise the strengths and weaknesses of science and maintain a positive outlook toward learning science and toward themselves (p. 464).

Coble and Koballa, Jr (1996) add other outcomes of teachers’ subject knowledge. Those are: “*scientific enterprise, history of science and thematic ideas*” (p. 463). In terms of the *scientific enterprise*, all science teachers need to understand science as a human endeavour and use scientific inquiry as an enterprise process that can be used to explain and predict some questions of human interest. Teachers also must be acquainted with the history that brings context to an understanding of the scientific enterprise. They also need to recognise the *thematic ideas* or organising ideas that transcend the boundaries of the science, technology and other school subjects. For example, systems, models, change and evolution, social issues and so on should be a part of the thinking and explanations of all teachers.

Coble and Koballa, Jr (1996) argue that teachers of science to be able to meet the instructional challenges that accompany the demands of the classroom, they must learn and know the major elements that constitute the common core of teachers’ subject knowledge.



To know and learn these elements, Ball & McDiarmid (1990) identify three sources of teachers' subjects-matter: pre-college curriculum, college curriculum and teaching the subject.

### ***1) The pre-college curriculum (school curriculum)***

When the student teachers begin their university courses, they already have certain knowledge about science (Mellado, 1998). They usually spend between 12 to 13 years in schools prior to entering college. During this period, they study mathematics, science, social studies, and language. Teachers' subject matter understandings are significantly shaped through their pre-college education.

### ***2) The college curriculum (subject matter courses)***

Subject-matter college courses provide specific academic subject or subjects for prospective teachers. Secondary education teachers usually concentrate on one or two disciplines (major and minor) whereas elementary education students study the broader range of survey and introductory courses in a variety of disciplines: Science, Mathematics, Language, Sociology, and Pedagogical Aspects. According to NCSESA (cited in Coble & Koballa, Jr, 1996), sufficient depth for secondary teachers is required to guide inquiries based on pupils' questions where breadth is required at the elementary level. At the middle level, the depth of the teacher's science content knowledge falls between that of the elementary and secondary teachers, with greater emphasis on breadth of science knowledge to meet the demands of the interdisciplinary curriculum.

Subject-matter courses should provide the intellectual resources, the essential cultural capital, and the knowledge. This is in order to foster a spirit of inquiry, as well as critical intellectual dispositions and skills. These courses should also educate prospective teachers

to be able to grapple with fundamental questions about ideas and ways of knowing, and to know the sort of questions and problems on which different disciplines focus.

### ***3) Learning subject matter through teaching:***

The experience of teaching in the classroom is also an essential source of teachers' subject-matter learning. They can learn content through teaching, from a student's question, a particular textbook activity, or an intense class discussion.

Subject-matter courses are crucial for preparing prospective teachers, thus, the examination of the adequacy of teacher education in this area is also important. The following is a review of the literature related to the subject-matter courses.

Coble and Koballa, Jr (1996) indicate that although, the crucial purpose of the science subject-matter courses is to develop a *firm knowledge base* that can be used to develop instruction, few of these courses provide prospective teachers the appropriate opportunities to use the knowledge (p. 471).

NRC, Arons, and Carter, *et al*, cited in (Coble and Koballa, Jr, 1996) indicate that there are possible dangers delivering and implementing science subject matter courses. For example, some of them consist of large lectures where concepts are conveyed verbally by an instructor. In these courses, science is presented as a body of facts to be learned, with little emphasis given to science as a process of investigation. These courses also include too much knowledge presented in too brief time for students to understand science concepts, principles and theories. These courses also teach isolated concepts and rote problem solving, while neglecting critical thinking, collaboration and open-ended laboratory inquiry.

On the other hand, in relation to the change in the cultural values within the higher education institution, Tobias cited in (Coble and Koballa, Jr, 1996) identified elements of successful science learning experiences. The change is from a world of individual competition and isolationism to one of learning community. The *characteristics* she found in successful science preparation programmes include “*real laboratory problems, attention to the process of teaching and learning, group work, faculty functioning as managers of change, and convenient access to computers and laboratories*” (p. 472). Lawson *et al* (cited in Coble and Koballa, Jr, 1996) developed an introductory biology course that uses the *learning cycle method* of instruction. In this course, “*science laboratory explorations of biology phenomena precede lecture and discussion, and lectures incorporate a historical perspective. The result of this course indicated that students complete it with an enhanced understanding of nature of science inquiry and improved reasoning abilities*” (p. 472).

Other studies have been conducted to find out the effectiveness of college subject matter courses on teaching of teachers. For instance, Druva and Anderson (1983), in their meta-analysis of subject matter and education preparation on teaching of science teachers, concluded that both science courses and education courses are significantly and positively accommodated with successful teaching. Hashweh (1987) studied the effects of subject-matter knowledge in the teaching of biology and physics. He concluded that the effects of it on teaching were apparent through the teacher’s use of evaluative structures. Ball and McDiarmid (1990) asserted that there is empirical evidence to support the view that subject knowledge significantly and positively affects teacher teaching.

Clearly, a good preparation of subject matter in teacher training is extremely important. However, the knowledge of learner, general pedagogy, and curriculum materials are also essential (Coble and Koballa, Jr, 1996). The pedagogical knowledge will support



prospective teachers to teach effectively. In addition, their pupils will learn in a significant and meaningful way. Thus, the following section discusses the pedagogical courses.

### **3:6:2 Pedagogical Courses**

In the following discussion, the term “pedagogical courses” is used interchangeably with professional courses and educational courses (Grossman, 1989 & Hewson *et al.*, 1999).

#### **3:6:2:1 The Importance of Pedagogical Knowledge**

Prospective science teachers are need to be grounded in pedagogical strategies that promote learning science content (Kelly, 2000). They need to have sufficient pedagogical knowledge, but the interpretation of pedagogical knowledge has led to a variety of definitions. Shulman (1987) defines pedagogical content knowledge as the combination of content knowledge, pedagogical knowledge, knowledge of curriculum, and knowledge of learning and students. Grossman (1989) also indicated that pedagogical knowledge includes

*overarching conceptions of what it means to teach a particular materials and curriculum in a particular field, knowledge of students’ understanding and potential misunderstandings of a subject area and knowledge of instructional strategies and representations fore teaching particular topics (p. 25).*

According to Manouchehri (1997), this domain includes: knowledge about the most useful forms of representation of ideas, understanding of complexities of teaching and learning certain concepts, and learners’ cognitive obstacles as they encounter various topics (p. 201).

Thus, obviously, this kind of knowledge is very important for teaching and learning. Grossman (cited by Manouchehri, 1997) clearly describes the importance of this area of knowledge for teaching and learning by stating that:

*If teachers are to guide students in their journey in to unfamiliar territories, they will need to know the terrain well. Both knowledge of content and knowledge of the best way to teach that content to the students help teachers construct meaningful representations, representations that reflect both the nature of the subject matter and the realities of students' prior knowledge and skills (p. 201)*

Smyth (1987) refers pedagogical knowledge in the context of teaching and learning to “*a systematic procedure for advancing learning ... to act pedagogical means to act in ways that empower learners*” (p. 2). As he points out:

*Pedagogues ask questions, while articulating their theories about teaching and learning ---- they verbalize why they do what they do in their teaching, interrogating their knowing so as to uncover why it is they accept current practices, and questioning the veracity of the social conditions that support and sustain them (p. 2).*

This is stressed by Geddis (1993) who states that “*the acquisition of pedagogical content would appear to be central in learning to teach*” (p. 682). Coble, and Koballa, Jr (1996) argue that pedagogical content knowledge is reflected in a teacher's understanding of what concepts are difficult for pupils to learn, the selection of appropriate instructional materials, and the use of *metaphors* and *analogies* to help pupils make sense of a learning experience (p. 468).

Pedagogical content knowledge is a crucial aspect of the teacher preparation programmes, as Peterson and Treagust (1998) argue: pedagogical knowledge in a pre-service teacher education programme is very important to develop teachers' knowledge base for teaching. In Grossman's (1989) explanation of *pedagogical knowledge*, she associated this term with *professional courses*. Hewson *et al* (1999) also say: “*there is no question that professional coursework is an essential component of any teacher education program*” (p. 380).

According to Kelly (2000), pedagogical content knowledge in science education is not the knowledge expected of practising scientists, but rather it is a collective, working



knowledge of science that enables the teacher to re-cast science in a way that effectively communicates understanding to the learner whether the negotiated experiences involve discussion, inquiry-based investigations, or reflective exploration and explanation (p. 756).

Coble, and Koballa, Jr (1996) argue that teachers of science, regardless of levels, need more than a good foundation in science. They need *science pedagogy*, the knowledge of how to teach science, to create a quality science learning environment for pupils. So, in this regard, they must be trained to be familiar with science pedagogical knowledge. Coble, and Koballa, Jr (Ibid.) stress that pre-service teacher programmes should help prospective teachers construct the understanding they need to be successful teachers of science.

Professional components or educational courses of pre-service science teacher programmes normally include methods courses, including science methods, seminar, practice and so on; and other courses in such areas as educational psychology, foundations, language and literacy (Coble, & Koballa, Jr, 1996 and Kelly, 2000). Coble, and Koballa, Jr (1996) argue that pedagogical courses, such as science methods courses, *shoulder the responsibility* of educating prospective teachers to be pedagogically effective teachers (p. 472).

Taking into account all of these views, it is clear that the pedagogical courses (professional courses) are crucial elements in the pre-service teacher programmes.

### **3:6:2:2 Effectiveness of Pedagogical Courses**

In investigating the effectiveness of the professional courses, Fullan (1991) argues that most student teachers will say that they get too much theory that it is irrelevant and a waste of time. In addition, there is a little impact of these components on educating prospective



teachers, whereas, many professors of education, especially those in the social science disciplines, will argue that student get too little theories of education and teaching.

Grossman and Richert (1988) argue that teacher education courses do influence prospective teachers and that the possibility for that influence will grow as they develop the understanding of the broad and complex knowledge base for teaching. They add that the curriculum of teacher programmes needs to reflect the knowledge base of the profession in order to affect educating student teachers. Fullan (1991) stresses that the *integration* of theory and practice is a desirable goal for the effectiveness of these courses.

Boulianne and Weston (1987) conducted an evaluative study of a teacher education programme at a university in Ecuador. A questionnaire was used which derived from the professional components of the Faculty of Education curriculum: academic concentration, general culture and pedagogical training. The pedagogical training section comprised 14 compulsory courses. Another questionnaire was used to evaluate professional competencies of the Faculty's professors. It included three categories: Instructional process; Theories and Foundations; and other Professional Attitudes and Activities. The results indicated that the secondary school teachers rated all items in the curriculum as important. The teachers felt very strongly that they had been poorly prepared by the Faculty of Education. The most serious problem was in the Instructional Process Category such as instructional methods and techniques of evaluation. They mentioned their lack of preparation in the actual teaching process, the lack of practical application of theory, and the weakness of the practice teaching component of their programme. In addition, the findings showed that the professors lacked the competence to teach and displayed poor attitudes toward their students. The lack of resources (libraries, laboratories, classroom space, etc.) was another result of this study. Boulianne and Weston (1987) suggested the priorities in order of importance seemed to be: to emphasise the instructional process

portion of the curriculum; to improve teaching in the faculty; to consider a more effective allocation of resources. The courses could be kept in place, but the content must be taught more effectively with emphasis placed on the practical aspects of teaching process. The re-examination of the curriculum and content of courses was also recommended. This study also suggested that well-structured professional development programmes might be implemented to improve the knowledge based of the professors and bring them up date with more current teaching techniques.

San (1999) investigated the extent to which beginning primary and secondary teachers in Japan received professional courses and training at the University of Hiroshima. The results of a questionnaire survey indicate that the extent to which the teachers have benefited from the education curricula was very low. So, this implies the need to reform the traditional initial teacher training programmes and to improve the context of the courses, methods and assessment procedures of the teacher education programmes.

It is important to provide pre-service teachers with a coherent and integrated set of skills of pedagogical content knowledge (PCK) through professional/pedagogical courses. Cochran *et al* (1993) reviewed the related literature of teacher education and suggested a model of PCK that can serve as a framework for pre-service teacher programmes. This model is based on the *constructivist* view of learning and its application to teaching and teacher education. PCK model includes four integrated components of “*pedagogy, subject matter, student characteristics, and the environmental context of learning*” (p. 266). This model represents the following ideas:

- the changes in a pre-service understanding in each of the four components because development in each area begins with a limited focus and becomes more elaborate through programme experiences and reflective activities;
- the growth of pedagogical content knowledge;



- the simultaneous integration of four PCK components, which theoretically become so integrated and so interrelated: these integration processes should result in conceptual change and conceptual integration;
- the four components should not be acquired first and then somehow put together, but rather preparation programmes must promote integration by having teachers *simultaneously* experience the PCK components;
- the transformation occurs simultaneously in all four components they become integrated to form PCK;
- the developing of all the components of teacher understanding will be symmetrical. The relative contributions of the four components to PCK development will vary during students' pre-service programmes.

To apply PCK model to teacher preparation, Cochran *et al* (1993) suggest a series of ideas.

These are as follows (pp. 269-270):

- *PCK development requires conceptually integrated instruction across liberal arts, pedagogy and subject area courses for these types of knowledge to develop concurrently;*
- developing PCK in teacher preparation programmes may depend on the level focus of these programmes;
- the construction of pedagogical content knowledge results from multiple opportunities to teach, observe and reflect on one's own teaching and that of others in content area;
- development of PCK requires early, continued and authentic field experiences with opportunities for real teaching and follows up reflection and feedback;
- the development of PCK occurs through repeated experiences that deliberately promote simultaneous learning of the components;



- *case studies, peer coaching, cooperative classroom methods, hypermedia, microteaching, and team teaching*, promote PCK development. In addition, these methods should involve students in realistic, active contexts and through appropriate inclusion in teacher preparation programmes;
- *competent beginning teachers continue to develop toward more integrated PCK with experience*. So, in-service professional development training should be designated to enhance this process throughout teachers' careers.

To accomplish this model successfully, Cochran *et al* (1993) stress that pedagogical experts, subject area specialists and experienced teachers should cooperate in the delivery of teacher training programmes. Substantial and innovative course development, closely linked to field experience, are essential. In addition, the effectiveness of methods and procedures in these programmes should be evaluated and revisited. It must be acknowledged that such accomplishments require time, money and commitment.

In science education, the major responsibility for assisting prospective science teachers to be pedagogues rather than scientists lies on science methods course (Coble, and Koballa, Jr, 1996). This opinion is also shared by Kelly (2000) who states that there is an increasing evidence that to prepare individuals who will be better, more effective teachers of science, different learning methods are necessary. Science methods courses play an important role in the education of the student teachers. They provide them with techniques and skills of teaching that will help them to teach in schools.

Science methods course at the Texas Christian University was designed to assist pre-service teachers in gaining content knowledge, pedagogical knowledge, and pedagogical content knowledge for the teaching of science while preparing them for a life-long process of teacher learning. This course has the following goals (Kelly, 2000):

- assume the constructivist perspective and integrate science content with pedagogical strategies to engage pre-service teachers in active, inquiry-based explorations that provide opportunities to build upon previous knowledge and enhance the personal understanding;
  - promote interest and attitude in science through exploration and by relating the content to relevant, real-world concerns and issues;
  - empower teachers to create and develop the curriculum for use in their own classroom;
  - encourage the use of unique learning environments that capture the essence of science.
- In this particular instance, a local museum of science and history was chosen as the informal learning site;
- provide practice teaching experiences in different learning environments (p. 757).

The mentioned course demonstrates effective constructivist teaching practice, requires development of curriculum units and learning centres. A variety of approaches, including modelling for the pre-service teachers' constructivist teaching strategies, involving them in exploratory and reflective collaborative activities; requiring them to seek resources and develop their own teaching materials; and having them explore and teach science in the context of formal and informal learning environments, were employed. In addition, this course provided student teachers with opportunities to observe and reflect upon the learning styles of elementary students.

Results of the application of this course have shown that the methods course had a positive impact on most students. There is evidence that students gained new insights and understanding. Most expressed more positive attitudes towards science and science teaching and expressed greater confidence in their abilities to teach science. The results also show that there are indications that experiences gained from the course are influencing the way in which course participants who are now in-service teachers teach science. Some

of them designated and developed several other science units for their schools. Kelly (2000) concludes that the success of the study adds to the growing body of evidence that even a single science methods course based on an holistic, constructivist approach can reform and enhance teacher knowledge, confidence and attitudes. This may lead to the utilisation of constructivist strategies in teaching science.

In conclusion, the key to successful pedagogical courses is in design, organisation, integration and implementation of them. Courses, which integrate content and pedagogy, can be very effective in preparing teachers with pedagogical content knowledge.

### **3:6:3 Teaching Practice**

*... field experience offer distinct occasions for learning to teach. ... offer an opportunity to expose future teachers to the knowledge base of the profession* (Feiman -Nemser, quoted by Grossman & Richert, 1988: 53).

Teaching practice is thus a very important aspect of teacher preparation programmes. As Brooker and Service (1999) argue: teaching practice is an essential part of pre-service teacher education programmes and it is the most popular component with student teachers in these programmes. Henry (cited in McIntyre, Byrd and Foxx, 1996) lists the following factors as contributing to the popularity of teaching practice:

- links student teachers to the real teaching setting;
- exemplifies the concept of learning through experience;
- has a higher degree of emotional involvement, mostly positive;
- offers the opportunity for one-to-one teaching encounters;
- allows prospective teachers to induct into the existing school environment.



Grossman and Richert (1988) indicate that this component offers different opportunities for the growth of both knowledge and the skills of teaching. Alshannag (1998) indicates that the practicum is a crucial factor in developing student teachers' teaching methods. Fullan (1991) argues that teaching experience is valued by student teachers due to its importance.

Teaching practice is a major component of pre-service teacher preparation programmes that offers occasions for learning to teach in schools and helps student teachers to develop their teaching skills. For this reason, the UK and other countries such as the US, Australia, and the Netherlands have moved rapidly towards school-based teacher education (Calderhead & Shorrock, 1997) where schools play a much larger part in training prospective teachers (DfE, cited by Kennedy, 1996). In the Colleges of Education in Oman, the practicum starts early in the first semester of the second year of the programmes (Ministry of Higher Education, 1998b). The rationale for this is to encourage student teachers to become more effective in their teaching and to develop the skills and competencies required by prospective teachers.

At the Colleges of Education in Oman, the teaching practice has two major aspects. The first is the college-based practicum, which is intended to develop the student teachers' understanding of the knowledge and techniques that they can use in different kinds of lessons. This aspect is implemented inside the colleges through organised workshops during the training years. The second is the school-based practicum which is divided into, serial practicum and block practicum. In addition, the school-based practicum involves, micro-teaching, actual teaching and so on. Micro-teaching is achieved in the colleges whereas other aspects of the school-based practicum are implemented in the schools (Ministry of Higher Education, 1998b). (More details about these aspects are addressed in chapter two).

If these various aspects of teaching practice are not connected, pre-teacher-training programmes could fail to achieve their goals. McIntyre, Byrd and Foxx (1996) argue that the *disjointedness* of the components of a teaching practice may be responsible for its *ineffectiveness*. This is because pre-service teachers are unable to understand the whole while experiencing the myriad of disconnected areas of the programme. For example, many teacher training programmes fail to challenge their students to understand how ideas are connected or related to teaching practice (Ibid.).

The responsibility of preparing effective prospective teachers relies on both the higher teacher education institutions and schools. According to Edwards (1995), in the UK school-based teacher training and the partnership between schools and higher education institutions, schools will take *responsibility* for the training of student teachers in the following areas:

- *training student to teach their specialist subject;*
- *developing an understanding of how pupils learn;*
- *training students to manage classes and assess pupils;*
- *supervising students in relation to the school-based elements of the course;*
- *assessing student competencies in subject application and classroom skills (p. 596).*

Usually, before the beginning of the real practising of teaching in school, student teachers observe lessons in the cooperative schools. These experiences help them to understand the teaching and learning context. Student teachers have opportunities to observe what they have learned in subject-matter and pedagogical courses. According to Coble and Koballa Jr (1996), observations are important opportunities for student teachers to observe actual teaching lessons and to interact with their colleagues individually or in small groups and with their supervisors.



In general, student teachers begin their training to teach by a micro-teaching lesson. According to Cruickshank (cited in McIntyre, Byrd and Foxx, 1996), micro-teaching is a brief teaching encounter in which teachers teach 5 to 20 minutes lessons to a small group of pupils who are usually peers. It is a means used to help student teachers' transition from theory to practice (Coble & Coballa Jr, 1996). The purpose of a micro-teaching lessons is to practice a specific teaching skill(s) until the student teacher reaches an acceptable level of performance (McIntyre, Byrd and Foxx, 1996). Usually certain elements are demonstrated such as interactive questions and class management, through which the micro-teaching session is evaluated and a feedback is provided (Al Salmi, 1996).

Generally, the responsibility of training student teachers in schools is shared between the departments of the Colleges of Education and the cooperative schools. In England, at the University of Warwick, the University' tutors and mentors work together to meet the needs of training and to help trainees make demonstrable progress. There are two kinds of mentors: the school professional mentor, who acts as a training co-ordinator for all the trainees at the school, and a subject mentor, who offers subject specific support, e.g. in science. The mentors have responsibilities in three main areas (University of Warwick, 1998):

- a. *Managing trainee teacher learning*
  - I. *Liaison with the University*
  - II. *Arranging trainee timetables*
  - III. *Planning for progression-trainee development*
  - IV. *Checking trainee's own planning, documentation and record keeping*
  - V. *Supporting trainees in the completion of school-based tasks*
- b. *Providing training in school*
  - I. *Observing training teaching*
  - II. *Providing feedback*
  - III. *Holding a weekly review meeting*
- c. *Monitoring and assessing trainee teachers*
  - I. *Maintaining a training record*
  - II. *Organising assessment*



*III. Completing the appropriate summative assessment profile for each trainee and returning these to the Partnership Office by the agreed deadline (Section 4, p. 3).*

In Oman, at the Colleges of Education, the co-operating teachers have a very minor part in the teaching practice component (Scroggie, Bader & Khilifah, 1997). They provide the lessons for student teachers and sometimes observe them but do not give any formal assessment. The assessment of student teachers' work is left entirely to the college supervisors who are from the academic departments and the departments of educational studies. At the Sultan Qaboos University (Al Salmi, 1996), the supervision of teaching practice is done by the university supervisors and co-operative teachers. The university supervisors usually have a background in the subject-matter content and are specialised in the teaching field in the certain subject. Often, the assessment grade of student teachers is divided into: 80% from the university supervisor, 10% from cooperative teacher and 10% from the school principals.

The supervisors of the practicum play an important role in helping and guiding student teachers to be successful in their teaching in schools. Hewson *et al* (1999) show the important and significant role of field experience, supervisors, co-operating teachers, and project staff in assisting prospective teachers gain the confidence they needed to teach successfully in the schools. In addition, some studies report that the role of co-operating teachers and supervisors influence student teachers' attitudes (McIntyre, Byrd and Foxx, 1996).

Several studies have been conducted to investigate the effectiveness of the teaching practice. For instance, in Australia, Brooker and Service (1999) investigated the role of the teaching practice component of pre-service teacher education programmes in preparing teachers for the complex demands and challenges in schools. Data were collected by using a questionnaire and interviews. The questionnaire contains five areas of competence:

- 1) Using and developing professional knowledge and values.
- 2) Communicating, interacting and working with students and others.
- 3) Planning and managing teaching and learning.
- 4) Mentoring and assessing student progress and learning outcomes.
- 5) Reflecting and planning for continuous improvement.

The results of Brooker and Service's (1999) study show that the teaching practice was identified by pre-service teachers as allowing the greatest development of their competencies and enhancing their confidence in their own abilities.

In investigating the role of teaching practice on student teachers' beliefs about teaching, Nettle (1998) used a survey conducted before and after a three-week period of teaching practice. The results show that teaching practice changes student teachers' beliefs about teaching to be more positive.

Many researchers studied the length of teaching practice and the effectiveness of this in training student teachers. Davis (1982) and Thompson (1984) believe that teaching practice component adds little to help beginning teachers in becoming better teachers. McIntyre, Byrd and Foxx (1996) examined the literature of teaching practice and they found that increasing the length of teaching practice without analysis and reflection does not lead to professional growth. They suggested that teacher educators must begin to utilise methodologies that allow them to understand the complexity of teaching and to present this to teaching practice. Andrew (1990) evaluated differences between graduates of 4- and 5-year teacher training programmes. The results show that graduates from the 5-year programme were more confident at the conclusion of their preparation. They were more positive about the school environment, school administrators and pupils. They viewed their programme as better than the 4-year programme. McIntyre, Byrd and Foxx (1996)

concluded that a shorter teaching practice with well-integrated experiences is more likely to produce effective, thoughtful teachers for the twenty-first century than a lengthier programme whose major attribute is length (p. 176).

Although the subject-matter courses, the pedagogical courses and teaching practice are crucial components for any teacher training programme, this programme will not function to prepare effective prospective teachers if these components are not coherent and integrated. Thus, these aspects must not be taught separately. Coble and Koballa, Jr (1996) indicate that an effective programme is *the result when these parts are well-coordinated and incorporate cutting-edge thinking and practice* (p.475). These combination courses help teacher candidates to construct the pedagogical content knowledge (PCK) needed by novice teachers.

Fullan (1991) argues that research in this field of professional courses is needed. This opinion is stressed by Coble and Koballa, Jr (1996) who said, more needs to be known about the nature and effectiveness of the educational courses and field experience (p. 479).

For the purpose of this research, the focus is on the pedagogical components and the practicum aspects rather than subject matter courses.



### 3:7 Teacher Skills and Competencies

Teacher competence refers to “*the set of knowledges, abilities, skills and beliefs a teacher possesses and brings to the teaching situation*” (Mitzel, 1982b: 1894). It is defined in terms of what the teacher knows, believes, or can do. Kyriacou (1995) has discerned three important elements of teaching skills. These are:

1. *Knowledge*, comprising the teacher’s knowledge about the subject, pupils, curriculum, teaching methods, the influence on teaching and learning of other factors, and knowledge about one’s own teaching skills.
2. *Decision-making*, comprising the thinking and decision-making which occurs before, during and after a lesson, concerning how best to achieve the educational outcomes intended.
3. *Action*, comprising the overt behaviour by teachers undertaken to foster pupil learning (p. 5).

Calderhead cited in Kyriacou (1995) has suggested that it is useful to define teaching skills in terms of a number of features. They:

- are intended to achieve a particular goal;
- take account of the particular context;
- require precision and fine-tuning;
- are performed smoothly;
- are acquired through training and practice (p.2).

San (1999) states “*teachers’ skills are important factors in learning to teach*”. Kyriacou (1995) defines teaching skills as “*discrete and coherent activities by teachers which foster pupil learning* (p. 5). Effective teachers are expected to possess the required teaching competencies on entering into a professional training programme. Calderhead and Shorrock (1997) argue that learning to teach involves the acquisition of certain knowledge and skills that are essential to adequate classroom performance. So, it is assumed that pre-service teacher programmes are expected to train these teachers how to acquire and develop these skills in order to facilitate pupils’ learning. To acquire and develop teaching

skills, Perrott cited in Kyriacou (1995) identifies three stages in which teaching skills are acquired and developed:

1. The first stage is cognitive and involves developing an awareness, by study and observation, of what the skill is, identifying the various elements of the skills, and their sequencing, knowing the purpose of using the skill, and knowing how it will benefit the teaching.
2. The second stage is practice, normally in the classroom, but occasionally in a controlled setting as part of a training course in which there is a short practice of a specific skill.
3. The third stage is feedback, which enables the teacher to improve the performance of the skill by evaluating the relative success of its performance (p. 13).

These three stages are seen as a cycle, in which the third stage feeds back into the first one as part of an on-going development of the skills.

Teacher skills and competencies have been studied either to identify required teacher competencies and skills for effective teaching (Bennett, 1988; Patrick & Smart, 1998 & Wilson & Cameron, 1996), or to measure acquired skills held by teachers (Al Barwani & Ibrahim, 1997; and San, 1999).

The **required teaching skills** needed to help teachers to work effectively in schools, can be grouped into two kinds of skills: skills set out by a state's requirements and skills emerged from the findings of research.

Standards of competence required by newly qualified teachers in England and Wales are an example of the skills that are set out by a state's requirement (DfEE, 1998). These skills are classified into four major headings:

- 1) Knowledge and understanding.
- 2) Planning, teaching and class management.
- 3) Monitoring, assessment, recording reporting and accountability.
- 4) Other professional requirements.



In order to become a qualified teacher, competence must be demonstrated in all 81 skills under these headings.

In Oman, skills required for newly qualified teachers at the Colleges of Education are grouped into five categories (Ministry of Higher Education, 1996): (Summary of these competencies is addressed in chapter two).

- 1) Subject specialisation competencies.
- 2) Professional competencies.
- 3) Cultural competencies.
- 4) Continuing professional development competencies.
- 5) Community development competencies (Ministry of Higher Education, 1996).

Benett (1988) lists a group of teacher skills required for effective teaching as follows:

- *to be thoroughly conversant with subject matters;*
- *to be skilled in the diagnosis of children's understanding and misconceptions;*
- *to differentiate curriculum in relation to the range of pupils' attainments;*
- *to be skilled in task design and the choice of tasks whose intellectual demands are appropriate to teach child's capabilities;*
- *to portray curriculum in representations adequate to teach child;*
- *to organize classroom settings conducive to high pupil involvement;*
- *to monitor a variety of classroom events simultaneously and act accordingly;*
- *to generate and maintain pupil interest and enthusiasm;*
- *to create and maintain good social relationships;*
- *to relate and work with parents.*

Wilson and Cameron (1996) investigated student teachers' perceptions of effective teaching during a three-week teaching practice. Subjects were asked to write about issues or experiences of effective teaching that concerned them. Data were analysed and classified into three categories of effective teaching. These areas are: instruction, management and relationships. This research also identified three generalisations about the development of student teachers' perceptions of effective teaching. These are as follows:

- *student teachers develop from a 'teacher centred' to a 'pupil centred' view of effective teaching;*
- *student teachers develop from a 'control' view to a holistic view of classroom management;*
- *student teachers develop from a personal to a professional/outcomes view of relationships with pupils (pp. 192-193).*



Patrick and Smart (1998) in their study "*An empirical evaluation of teacher effectiveness: the emergence of three critical factors*" clarify the nature of teacher effectiveness and develop a measure for evaluating teacher effectiveness. 148 undergraduate students were asked to identify qualities of effective teachers. The analysis of the results indicates three interrelated dimensions of effective teaching. These are: respect for students, ability to challenge students, and organisation and presentation skills.

Any reform in teacher education calls for narrowing the gap between teaching theory and teaching practice. In this regard, Warham (1993) reviewed the models of teaching in order to suggest a model of competence. Warham's study concluded that a competence model which situates teaching in its social context, which takes account of the political nature of teaching and its professional power structures might more appropriately describe the activities of teachers.

In terms of the **acquired skills** held by teachers, for instance, Mifsud (1996) utilised a questionnaire to investigate the relationship between training and teaching competence as viewed by intending and beginning teachers in order to evaluate a teacher preparation programme run by the Faculty of Education, University of Malta. The relationship between perceived levels of preparation and competence was investigated through a survey applied to final year student teachers, first year teachers and teachers with two to four years of teaching experience. Teaching skills included in the survey are those which deal with teaching specific subject areas of the school curriculum, general teaching skills specific to the classroom situation and those which involve interpersonal skills. The results indicate that student teachers feel least prepared in general professional teaching skills, whereas the

teachers feel better prepared in these skills. Mifsud (1996) concluded that reflection on the processes of professional preparation and competence is of utmost importance.

San's (1999) study also indicated that both primary and secondary teachers perceived that the extent to which they developed knowledge and skills as a teacher at the end of their initial training was very low. San concludes that initial training is a very important factor that influences the initial preparation for the development of certain skills, such as subject knowledge and concepts, basic teaching techniques, class management and the use of teaching aids.

Al Barwani and Ibrahim (1997) also conducted a study to evaluate the effectiveness of the teacher education programme at Sultan Qaboos University in Oman by measuring the teachers' competencies. They found that while new teachers were deficient in some competencies, they demonstrated ability in others.

In conclusion, it is assumed that to be effective, prospective teachers should **acquire** the **required** skills. Calderhead cited in Kyriacou (1995) say, skills and competencies are acquired through training and practice. Thus, initial training programmes of teachers are important factors that help student teachers to develop their skills; i.e. planning, organisation, teaching, assessment, class management and use of teaching aids. These skills are important for successful teacher's performance and effective learning and teaching. Therefore, these programmes should be evaluated to explore whether they educate skilled and competent teachers or not. The focus of this research is on student science teachers' skills of teaching, assessment and evaluation, and problem-solving.

## 3:8 Problem-Solving Methods

One strategy of science teaching in the reformed general education in Oman is the use of a problem-solving approach as a method of experiential learning (Ministry of Education, 1995 & 1999a).

### 3:8:1 The Importance of Problem Solving Approach

Problem solving in science has become an important aspect of science education (Gayford, 1992). The results of Pehkonen's (1993) study indicated that problem solving is important because it is a means for developing pupils' cognitive skills and it helps pupils to master the subject content they have learned.

With this approach, the important aim is to develop creative and independent problem-solvers able to live in this rapidly changing era (Casey & Honwson, 1993 & Ministry of Education, 1999a). Garrett (1989) stresses that one way in which modern science courses seek to encourage creativity is to provide a problem-solving approach. He summarised the following features related to the creativity:

- *it is a fundamental aspect of the process of science, which in turn is now being seen as a prime feature around which science curricula are currently being designed;*
- *more specifically, problem-solving, another key component of current courses, requires an element of creativity if it is to be practised;*
- *the sort of cognitive creativity that is required in the practice of science is not likely to be encountered in those subjects usually termed 'creative';*
- *if creativity in all its forms is not continually exercised it will not develop (p. 128).*



Gayford's (1992) study also indicated that there is evidence that problem solving has a marked effect on improving motivation and often leads to improved understanding for pupils.

The *Leuven Centre for Instructional Psychology and Technology* (Belgium) has investigated the effect and importance of the problem solving approach (Corte, 2000). The project involved a series of 20 lessons that were taught by the classroom teachers. The effect of the project on pupils was evaluated experimentally with *pre-test/post-test/retention test* designed for an experimental group and a control group. The results of this project indicated a significant and stable positive effect on the pupils' experimental skills in solving application problems. The project also had a significant positive impact on children's pleasure and persistence in solving problems and their beliefs and attitudes as measured by a questionnaire. The experimental classes significantly performed better than the control group classes on a standard achievement test. The analysis of pupils' written notes on their response sheets from the problem tests showed that the better results of the experimental children were paralleled by a substantial increase in the spontaneous use of the heuristics taught in the learning environment. This finding was confirmed by a qualitative analysis of videotapes of the problem-solving processes of three groups of two children from each experimental class before and after the intervention. The results indicated that high, medium and low ability pupils significantly benefited from the project.

There is clear evidence that the problem solving approach is a very effective, significant, and important method in learning and teaching. In this approach, the focus of the learning process is on the pupil activities. At the core of it, pupils are encouraged to participate in their own learning rather than continue to be the passive recipients of an activity dictated entirely by the teacher (Cook, 1992). They are encouraged and enabled to take

responsibility for the learning process. In this approach, pupils feel better about themselves. This approach can better develop pupils' cognitive and affective aspects.

### **3.8.2. The Definition of Problem Solving Approach and its Learning Environment**

Newell and Simon (cited by Baumert, Evans & Geiser, 1998) say a problem is determined by the structure of the task, its context, and the pupil's previous knowledge. According to NCSM (cited by Pehkonen, 1993), problem solving can be understood as "*a process where previously acquired data are used in a new and unknown situation*" (p. 238). Peterson and Treagust (1998) state that:

*preservice teachers' education not only needs to develop their knowledge base for teaching,..., but they also need to begin developing the ability to make reasoned decisions when using this knowledge and applying it to a teaching situation...., and the possible approaches of teaching science that to take into consideration the prior experiences of learners (p. 217).*

They also indicate that the way of considering pupils' experience is using problem-based learning in teaching science. As Al Sowidi and Al Kalili (1997) and Ibraheem and Al Kalza (1996) argue the major method of experiential learning is the problem-solving approach. Henry (1993) also states that problem-based learning is one of the essential methods of experiential learning strategies.

In this approach, the prior experience of the pupils needs to be considered as an important element of effective learning. Stones (1994) says that problem solving is a form of learning. Peterson and Treagust (1998) argue that the learning takes place in response to the pupils' attempts in solving the problem. This depends on "*the prior knowledge and experience of students, and the knowledge and understanding acquired in addressing the current problem*" (p. 217). Stones (1994) also argues that pupils do not solve problems in areas of knowledge they know nothing about. He states that the best qualification for successful problem solving is an extensive knowledge of the appropriate field of study.

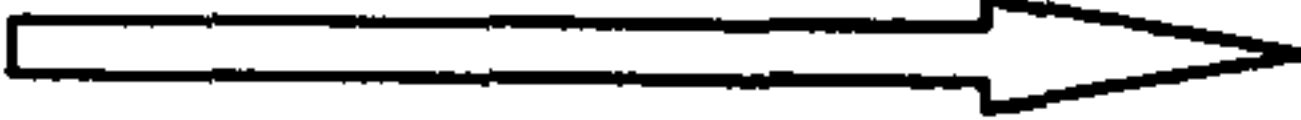
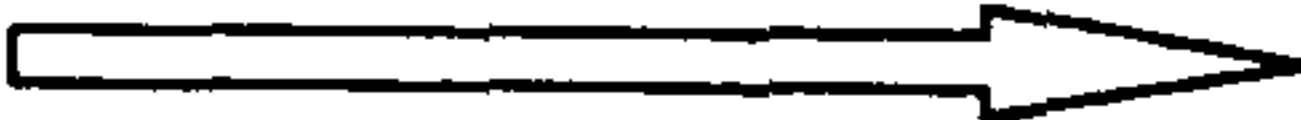
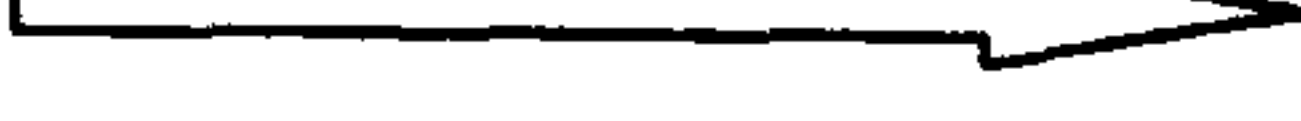
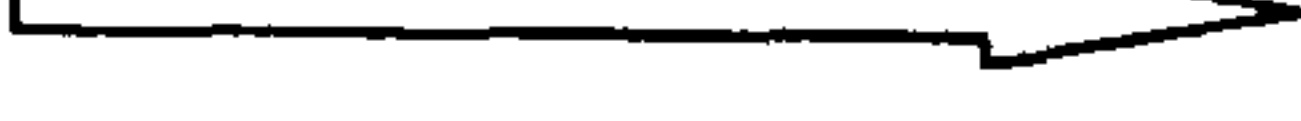




Generally, in implementing a problem-solving approach, designing a powerful learning environment is important (Ministry of Education, 1999a). In this regard, Corte (2000) summarises some major interrelated guidelines of the learning environment:

- 1) Learning environments should induce and support constructive, cumulative, and goal-oriented acquisition processes in all learners-also in the more passive ones – through a good balance between discovery learning and persona; exploration on the one hand, and systematic instruction and guidance on the other.
- 2) Learning environments should foster pupils' self-regulation of their learning processes: as pupils' competency in a domain increases, external regulation of knowledge and skills acquisition should be gradually removed so that they become more and more agents of their own learning.
- 3) Learning environments should embed acquisition processes as much as possible in authentic contexts that have personal meaning for students, are rich in resources and learning materials, and offer ample opportunities for collaboration.
- 4) Learning environments should flexibly adapt the instruction support especially the balance and self-regulation, taking into account individual differences among learners in cognitive aptitudes as well as in affective and motivational characteristics.
- 5) Because domain-specific and domain-general knowledge play a complementary role in competent learning and thinking, learning environments should integrate the acquisition of general (meta-) cognitive skills within the subject-matter domain (p. 254).

The Ministry of Education, Oman (1999a) identifies five major shifts in the environment of mathematics and science classrooms that will help to implement the problem-solving approach. These shifts are summarised below.



<b>Moving away from</b>		<b>Toward</b>
Classrooms as collections of individuals		Classrooms as mathematical and scientific communities
The teacher as the sole authority for right answers		Logic, scientific, and mathematical evidence as verification
Primarily memorising procedures		Mathematical and scientific reasoning
An emphasis on mechanistic answer finding		Conjecturing, inventing, and problem solving
Treating a subject as a body of isolated facts and procedures		Connecting science and mathematics, their ideas and applications

In Belgium, the *Leuven Centre for Instructional Psychology and Technology*, which was mentioned earlier, has carried out a research project as a contribution to the implementation of new trends of mathematical reasoning and problem-solving skills and their applicability to real-life situations (Corte, 2000). This project aims to design and evaluate a powerful learning environment, that can elicit, in upper primary school children, the appropriate learning processes for acquiring the intended competence in mathematical problem solving and positive mathematics-related beliefs.

The major changes in the classroom learning environment are related to the following components: the content of learning and teaching, the nature of the problems, the instructional techniques and the classroom culture (Corte, 2000). First, in terms of the content of learning and teaching environment, it focused on the acquisition by the pupils of an overall metacognitive strategy for solving mathematical application problems. Table 3:3 explains the competent problem-solving model underlying the learning environment.

**Table 3-3 The competent problem-solving model underlying the learning environment**

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Step 1: build a mental representation of the problem	
Heuristics	Draw a picture Make a list, a scheme or a table Distinguish relevant from irrelevant data Use your real-world knowledge
Step 2: decide how to solve the problem	
Heuristics:	Make a flowchart Guess and check Look for pattern Simplify the numbers
Step 3: execute the necessary calculations	
Step 4: interpret the outcome and formulate an answer	
Step 5: evaluate the solution	

---

Second, a varied set of carefully designed, realistic, complex, and open problems were used that differ from the traditional textbook tasks. These problems were presented in different formats: a text, newspaper article, brochure, comic strip, table, or a combination of these formats. Third, varied sets of activating instructional techniques were applied. The basic instructional model for each lesson consisted of the following activities:

- a short, whole-class introduction;
- two group assignments solved in fixed heterogeneous groups of three to four pupils, each of which was followed by a whole-class discussion;
- an individual task, also with a subsequent final whole-class discussion.

The role of the teacher was to encourage and scaffold the pupils to engage in, and reflect upon the kind of cognitive and meta-cognitive activities involved in the skilled model of problem solving.

Fourth, an innovative classroom culture was created through the establishment of new socio-mathematical norms about learning and teaching problem solving. Typical aspects of this classroom culture are: 1) stimulating pupils to articulate and reflect upon their solution strategies, mis-conceptions, beliefs and feelings relating to problem solving; 2) discussing what counts as a good problem, a good response, and a good solution procedure; 3)

reconsidering the role of the teacher and the pupils (e.g., the class as a whole will decide which of the generated solutions is the optimal one after an evaluation of the pros and cons of the different alternatives).

The components of this project could be adapted for science teaching. Corte (2000) concluded that a substantially modified learning environment, combining a set of carefully designed complex and realistic problems with highly interactive teaching methods and the introduction of new socio-mathematical classroom norms, can significantly improve pupils' mindful approach toward problem solving.

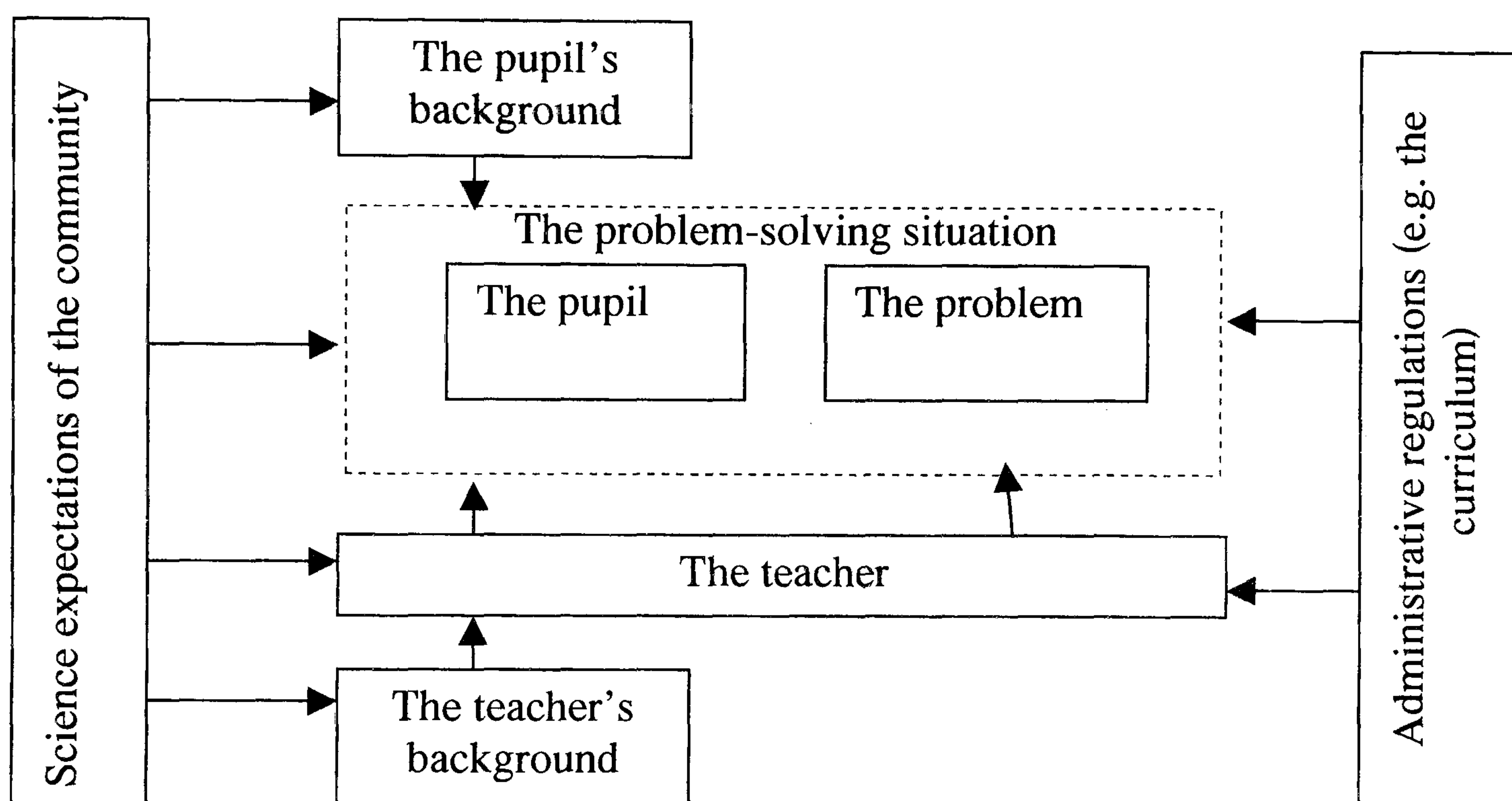
To implement problem solving approach effectively, Stones (1994) assumes that teachers should be particularly interested in helping pupils to go beyond the random learning of everyday life and trying to give pupils an insight into reducing randomness. However, if teachers do not have the required skills and abilities to use this approach in teaching, they will not be able to achieve this. They would have difficulties in considering the pupils' experiences, and in offering a powerful learning environment that helps pupils to use this approach effectively. So, the main factor in implementing this approach is through teachers' skills (Pehkonen, 1993).

### **3.8.3. Science Teacher's Skills and Problem Solving**

The challenge of using practical problem solving is how to tackle the teaching in an interesting and effective way (Stones, 1994). As Pehkonen, (1993) says the most important external influence in the problem-solving situation is the teacher, who usually gives the problem to the pupils. Thus, the teacher's skills, e.g. involving the pupils themselves in the activity, providing feedback and arranging practice are potentially important in helping pupils to develop useful ways of attacking problems (Stones, 1994: p. 172).



Frank (cited in Pehkonen, 1993) presented a model of the factors affecting the pupils' problem-solving behaviour. This model considers the most important external factor to be the teacher. Pehkonen (1993) argues that the teachers' background factors, teaching and learning experience, knowledge, and of course abilities and skills, affect their ability to design and implement a problem-centred approach to teaching science. Figure 3:2 shows the factors affecting the pupil's problem-solving situation in teaching science, including the teacher who is the most important factor.



**Figure 3:2: factors affecting the pupil's problem-solving situation in teaching science (adapted from Pehkonen, 1993)**

Casey and Howson (1993) summarise the teaching skills and abilities related to problem solving as the following: effective problem-centred teachers are reflective and experimental in their approach to facilitating problem-solving; develop lessons concentrating on the reasoning processes used by pupils; develop activities posing open-ended problems for the pupils to solve; incorporate the steps of scientific thinking throughout the curriculum (e.g., making predictions, testing and evaluating these predictions); let pupils discover and plan their own solutions to problems rather than give answers; and extend pupils' thinking throughout the lesson through open-ended questions.

Corte (2000) also argues that the powerful learning environment created for the problem-solving method requires changes in the role of teachers. Instead of being the main, if not the only the source of information (as is often still the case in general educational practice) the teacher becomes a “*privileged*” member of the knowledge-building community. S/he creates an intellectually stimulating climate, models learning and problem-solving activities, asks thought-provoking questions, provides support to learners through coaching and guidance, and fosters students’ agency over and responsibility for their own learning. Indeed, it is not just a matter of acquiring a set of new teaching techniques, but also calls for a fundamental and profound change in teachers' beliefs, attitudes, mentality and of course skills. According to Corte (2000), achieving this will require substantial investments in the training of teachers, taking into account the contextual, social and organisational dimensions of classrooms and schools.

In general, applying a problem solving approach requires a set of steps that might be used as a guide to implement this approach. Stones (1994) presents a type, which may foster problem-solving ability and might be used as a guide to teaching problem solving. This type involves the following:

- 1) *Identify the problem*: the teacher helps pupils acquire insights into ways of tackling any problems in the same general field of study. The vital importance of clarifying the nature of the problem is well illustrated by the difficulties that ensue when this clarity is not achieved (pp. 172-173).
- 2) *Bring in mind the relevant concepts and principles*: It is necessary in problem solving for the learners to have knowledge relating to the field. Once it is established that learners have acquired a sufficient body of relevant concepts and principles, they can be encouraged to apply them to unfamiliar contexts to test their relevance to the problem in hand. A teacher can help pupils remember ideas that might be useful by

cueing them about aspects of the problem that might be helpful. Furthermore, reminding them of the properties of some of the elements of the problem will give them a useful focus to solve the problem. It is important, too, to encourage the learners not to be restrictive in their thoughts., wide range in thinking about the problem may help them to see connections they might otherwise have missed (pp.173-174).

- 3) *Analyse the task: a heuristic approach* for pedagogical analysis because it is very closely linked with the ideas of bringing to the fore of one's mind ideas that relate to the problem. Explaining to pupils that problems can be analysed, demonstrating how this can be done with a variety of problems and giving them guided experience in practising this method will equip them to tackle things on their own later.
- 4) *Give prompted practice*: careful planning by the teacher with regard to prompted practice and practice with feedback should be aimed at enhancing pupil motivation by ensuring that the learners experience a fair degree of success in solving the problems.
- 5) *Developing independent activity*: the aim of problem solving is to help pupils to deal with problems independently. The *heuristic approach* is likely to be a useful approach to achieve this aim.

Teachers do not necessarily have to follow the key steps one by one, but they can adapt these points in their own ways.

#### **3.8.4. Problem Solving and Teacher Education**

Pre-service teacher training programmes should play a crucial role in educating student science teachers in the field of problem solving. According to Stones (1994), teachers' lack of knowledge and skills in use of the problem solving approach might be because they have not been trained in their pre-service teacher training programmes. Pehkonen (1993)



indicates that for teachers to be able to teach using the problem solving approach, requires them to be familiar with problem solving both in theory and practice.

Casey and Howson (1993) argue that teacher educators must make fundamental changes in how to prepare teachers to teach using the problem-solving approach. This opinion is stressed by Kahle and Boome (2000) who say that pre-service teacher training programmes should include curricular materials that address the problem solving approach.

Therefore, the problem-solving approach should be an important element of the pedagogical components of teacher preparation programmes. Casey and Howson (1993) proposed a detailed model for a teacher education programme based on a problem-centred approach to teaching. This model is based on a programme they developed over ten years at the Boston College. The researchers suggest that a successful problem-centred programme must focus on how can teachers help pupils become effective, creative and independent learners.

This model presents four key elements of a teacher education course designed to teach a problem-centred model to student teachers. These elements are: 1) the conceptual foundation, 2) strategies for introducing the major components of the model, 3) strategies for helping the pre-service students make transformations in their reflective thinking, attitudes, and emotions, and 4) the organisational structure (Casey and Howson, 1993). The following is a brief description for these components:

1. *Developing the problem-centred concepts within the course*: it is important at the outset of the problem-solving course to introduce the basic concepts underlying this approach. Prospective teachers should understand how a problem-solving approach differs from the traditional teaching approaches. In addition, Casey and Howson (1993) believe that

the best way for student teacher to understand these approaches is to experience the differences themselves as learners.

2. *Strategies for introducing the major components of the model:* for the construction of the new understanding of student teachers' role in the problem-solving approach, Casey and Howson (1993) suggest: "*integrating content and problem-solving lessons; scaffolding provided by all members of the teaching team; developing questioning skills and introducing strategies for problem-solving through the hidden curriculum*" (pp. 364-365).
3. *Strategies for developing teachers' reflective thinking skills and attitudes:* teachers should be reflective as they teach, Casey and Howson (1993) suggest "*requiring focused journal writing, requiring detailed written evaluation of the lessons, using self-assessment and using videotaped lessons*" (pp.366-367). In terms of the transformation of student teachers' attitudes towards their teaching roles, Casey and Howson (1993) recommended that the course should play a major responsibility in helping the student to deal emotionally with the fear of trying something new, and providing evidence that other students have achieved this transformation by showing them videos and lesson plans from former students.
4. *Organisational structure of the course:* according to Casey and Howson (1993), to organise a successful course using a problem-solving approach, its elements should be incorporated. In addition, all the team who is responsible for training student teachers: tutors, college supervisors, and co-operating teachers, must work together in order to provide a supportive and flexible environment to train the pre-service teachers in applying a problem-solving approach. Furthermore, assessing the student is an important factor in the course. It is important to evaluate and grade student teachers' skills and abilities to analyse the strengths and weaknesses of the lesson.



For this course to be effective, Casey and Howson (1993) insist that teaching practice should stress the problem-solving approach in which student teachers make a permanent connection between the problem-centred strategies learned in the course and their ultimate practice of teaching.

In investigating the effectiveness of teacher education programmes, Peterson and Treagust (1998) concluded that pre-service programmes helped the student teachers to develop both their knowledge base for science teaching and their ability to make reasoned judgements about their teaching when they were provided problem-based learning situations in their training programme.

There is very little published material on how to measure teachers' skills in use of the problem solving. However, Casey and Howson's (1993) study suggested a list of skills which can be used in evaluating progress in designing and implementing a problem-centred approach to teaching. This list consisted of 16 statements. The current study adapted this list of skills for the evaluation of pre-service teachers' skills in using problem-solving method in their teaching.

Hong (1998) elicited the conceptions of US and Korean pre-service elementary teachers on teaching problem solving. This study was to provide teacher educators with relevant information that they could utilise in their instruction. Three general categories emerged from the analysis of participants' statements in both countries. These categories are: instructional strategies, concerns about student ability, and prior learning experiences, in their instructional planning of problem solving. The subcategories of problem solving method were: a) understanding the problem situation, b) using manipulatives for instruction, c) verbal explanation of problem solving processes, d) acting out, and e)



drawing diagrams or pictures. A few participants added additional instructional strategies, such as use of small numbers and writing equations.

The results of concerns about student ability included a) students' entry level knowledge/skills and b) presumptions about students' entry-level knowledge/skills. Prior learning experiences included: a) prior educational experiences, b) teacher education experiences (practicum or classroom observation) and c) tutoring experiences.

In essence, student teachers should be trained to use this approach in their teaching by providing them with conceptions related to the problem solving approach and opportunities to practice this approach, both inside the training institutions and in the schools during the teaching practice.

### **3.8.5. Problem Solving, Science Process Skills and the Nature of Science**

Vesilind and Jones (1996) indicate that process skills are one of the most important aspects of the reforms of science teaching. They play a crucial role in problem solving. For example, process skills such as observing, classifying, communicating, predicting and experimenting skills are essential for solving problem (Ministry of Education, 1999a). McCombs and Marzona (cited in Baumert, Evans & Geiser, 1998) also indicate that problem solving is a dynamic interactive process of skills. Casey and Howson (1993) state that the primary goal of the problem-based method is to develop the pupils' reasoning processes. Those processes are important for understanding science. For this reason, some authorities, such as *National Science Educational Standards* and *Project 2061* in the United States and elsewhere have suggested that understanding science will be increased by greater instructional emphasis on scientific process (cited by Gallagher, 2000).

Vesilind and Jones (1996) associate the process skills with hands-on and summarise four meanings of hands-on science:

- it is the nature of science; embedded in inquiry processes and is not a goal separate from pupils' scientific investigation;
- stimulates the motivation of pupils and encourages them to continue studying science;
- meets pupils' developmental needs;
- constructivist science teaching that focuses on pupils' conceptual growth promotes the meaning of hands-on science.

In teacher education, Boone and Gabel (1998), in a part of their study, measured the acquisition of the science process skills held by primary student science teachers at Indiana University. The instrument used in their study required students to answer questions involving observation, inference, prediction, manipulated variables, responding variables, controlled variables, hypotheses, graphing, operational definitions and classifying. The results indicate that student teachers had acquired the science process skills to a high degree.

Boone and Gabel (1998) concluded that the changes in the acquisition of process skills might be a result of change in both the required courses and the new requirements that prospective teachers experience during their training. Both of these changes are important for prospective teachers because they are crucial elements in teaching science to pupils.

In terms of the nature of science, Hodson (1988) states that if science teachers are to help pupils completely understand the content of science, they need to recognise the nature of science. This view is stressed by Palmquist and Finley (1997) who say that this recognition is necessary because the scientific knowledge chosen by science teachers and the teaching strategies employed rely on a particular view of the nature of science.

In trying to define the nature of science, Palmquist and Finley (1997) reviewed a huge literature related to the nature of science. They investigated a total of 24 different domains of the nature of science and concluded that each of these areas fits into 1 of 5 broad categories: scientific knowledge, scientific method, scientific theory, scientific law and the role of a scientist (p. 596).

Driver, Leach, Millar and Scott (1999), in their article "*Perspectives on the nature of science*", suggest ideas that command broad consensus and might usefully be explored in a study of pupils' understanding. These ideas are:

- scientific inquiry involves the collection and use of data (evidence). This may be used to provide the raw material which an explanation has to account for; or to test proposed explanations;
- scientific explanations are based upon generalisations (laws) and theoretical models (theories);
- laws and theories are always understood by data. That is proposing a law or a theory always involves going beyond the available data. So, they are inevitably conjectural;
- choices between competing theories are based on criteria such as accuracy of prediction, consistency both internally and with data, breadth of scope, simplicity and fruitfulness in suggesting lines of enquiry. Judgement is, however, involved in deciding how these apply to any given case.

Eflin, Glennan and Reisch (1999) also reviewed the literature of the nature of science and ended up with the following areas of consensus about the nature of science:

- *the main purpose of science is to acquire knowledge of the physical world;*
- *there is an underlying order in the world which science seeks to describe in a maximally simple and comprehensive manner;*
- *science is dynamic, changing, and tentative;*
- *there is no one, single scientific method (pp. 108-109).*

Based on the above views of the nature of science, it can be assumed that the role of a pupil as a problem solver in any problem-solving situation is applying a scientific



approach/inquiry. This involves the collection and use of related knowledge and data in order to solve a problem. In addition, the inquiry must be based on laws and theory, findings and solutions must be supported by the data available.

Palmquist and Finley (1997) argue that if one accepts the importance of understanding the nature of science, then pre-service science teacher education programmes are obliged to develop new teachers who understand contemporary views of the nature of science and their applications to teaching.

Palmquist and Finley (1997) concluded that pre-service teachers need the chance to express and discuss their views of the nature of science. They can support their decisions on what and how to teach with contemporary aspects of the nature of science. They recommended that more time in science teaching methods classes should be spent looking at the relationship between the nature of learning and the nature of science. The pre-service teachers' views of the nature of science might become more definitive and more contemporary if the nature of science were more related to the nature of teaching and learning.

Gustafson and Rowell (1995) reviewed the literature of pre-service teachers' ideas about children's learning, science teaching and the nature of science and they concluded that these studies indicate that pre-service teachers hold a variety of conceptions. Those conceptions can affect the ways in which pre-service teachers eventually approach science teaching in their future classrooms.

Due to the importance of the nature of science, this aspect must be a part of teacher training programmes. For example, in England and Wales, Trainees must demonstrate that they know and understand the nature of science. This includes the following (TTA, 1998):

- *science is a way of making sense of natural phenomena and as such involves the interaction of an existing body of knowledge with the “discovery” of new evidence, leading to a re-interpretation or explanation of phenomena and processes;*
- *scientific knowledge and explanations may change as new evidence is collected and thinking is challenged;*
- *science is a co-operative activity which involves a world-wide community of scientists and others in developing more powerful ways of understanding the natural world;*
- *science does not explain every phenomenon;*
- *scientific knowledge and understanding can be used in solving a range of problems but that the available scientific evidence is often limited, and its application to everyday problems often entails ethical and moral questions (p. 17).*

In the Colleges of Education in Oman, the nature of science and science processes are addressed theoretically and practically within the science teaching methods courses. These aspects form about 10.6 % of this course (Ministry of Higher Education, 1998b).

In investigating the effect of teachers training courses on enhancing teachers' views of the nature of science, Gustafson and Rowell's (1995) elicited the elementary pre-service teachers' conceptions of the nature of science. They used questionnaires and semi-structured interviews at the beginning and end of two undergraduate science teacher education courses. They found that the final ideas of pre-service teachers were not remarkably different from their initial ideas. There was little change in their ideas about the nature of science. Some teachers mentioned some new conceptions such as the conceptions of science-technology-society interconnections. On the other hand, other studies (Akerson, Abd-El-Khalick & Lederman, 2000 & Palmquist and Finley, 1997) indicated that the pre-service teacher courses have significantly improved the teachers' conceptions of the nature of science. For example, the results of Akerson, Abd-El-Khalick & Lederman (2000) study indicated that the science methods course in which pre-service teachers were engaged in specially designed activities that were coupled with explicit nature of science instruction

was effective in enhancing pre-service elementary teachers' views of the nature of science. They noted that participants made substantial gains in their understanding of the target aspects of nature of science.

Palmquist and Finley (1997) also conducted a study to determine pre-service science teachers' views on the nature of science and described the changes in those views that occur during a teacher education programme. The participants' views about the nature of science were ascertained by a survey and a follow-up interview administered before and after the science teaching methods courses and associated practicum. The results of this study indicated that, before entering the methods courses, the participants had a contemporary view of scientific theory, knowledge and the role of a scientist and traditional view of scientific methods. After completing the methods courses, the participants' views had extended and were much more contemporary. Fewer teachers held traditional views. The number of confused and weak views decreased by more than half. According to Palmquist and Finley (1997), this implies that science methods courses can contribute to a positive change in pre-service teachers' views of the nature of science.



### 3:9 In-Service Training

If pre-service teacher programmes do not play an effective role in training student teachers to acquire the required skills and knowledge, either in the field of problem solving or other teaching and assessment methods, it is very important that this dereliction should be remedied in in-service training programmes. Plummer and Barrow (1998) indicate that in-service programmes are important for beginning science teachers. These programmes provide assistance to facilitate new teachers in their successful adjustment as professional teachers. To be effective, these programmes should meet the demands of reforms. Abdal-Haqq (1996) summarises some characteristics of effective professional development that meets the demands of the systematic reforms such as improving the required pedagogical skills and improving teachers' subject-matter knowledge. He mentions that the effective professional development:

- is on-going;
- includes training, practice, and feedback; opportunities for individual reflection and group inquiry into practice; and coaching or other follow-up procedures;
- is school-based and embedded in teacher's work;
- is collaborative, providing opportunities for teachers to interact with peers;
- focuses on pupil learning, which should, in part, guide assessment of its effectiveness; encourage and support school-based and teacher initiatives;
- is rooted in the knowledge base for teaching;
- incorporates constructivist approaches to teaching and learning;
- recognise teachers as professionals and adult learners;
- provides adequate time and follow-up support; and
- is accessible and inclusive.

As the professional development is an on-going process, the school climate should facilitate the on-going process of development of teaching skills. Waterhouse cited in Kyriacou (1995) states some characteristics of a positive climate for developing teacher skills include:

- a sense of common ownership amongst staff for the educational aims to be achieved;
- a constant generation of ideas;

- sharing problems;
- mutual support;
- respect for each other's opinions;
- an open and co-operative approach to dealing with conflicts and crises;
- allowing styles to vary according to situations and needs;
- encouraging anyone, not just leaders, to propose improvements;
- 'organic' rather than 'bureaucratic' management style (the former being more informal and flexible, with decision-making shared rather than directed from the top through a hierarchy, and with less emphasis on reports and record keeping) (pp. 15-16).

Effective professional development can provide teachers with means to engage in exploration, research-based inquiry, reflection, experimentation, while providing collegial sharing of knowledge and opportunities to draw on the expertise of others in the community (Wise, Spiegel, Bruning, 1999). Plummer and Barrow (1998: p. 295) also report that induction programmes generally include components such as graduate courses, workshops or seminars, supervision, and support in the form of handbooks and newsletters. Huling-Austin cited in Plummer and Barrow (1998) listed five common goals of induction programmes. These are to (p. 295):

1. Improve teaching performance.
2. Increase the retention of promising beginning teachers during the induction years.
3. Promote the personal and professional well-being of beginning teachers by improving teachers' attitudes toward themselves and the profession.
4. Satisfy mandated requirements related to induction and certification.
5. Transmit the culture of the system to beginning teachers.

Many studies have reviewed the effectiveness of the in-service teacher education programmes. For example, the results of Luft's (1999) study indicate that problem-solving classes provided by in-service programmes gave participating teachers an opportunity to address their instructional needs pertaining to problem solving. These programmes develop a view of the student in the context of problem solving, redefine their understanding of problem solving, reflect upon their own instructional practice, and engage in a cooperative and mentoring dialogue with peers.



In Nebraska, professional development workshops aimed to help teachers shift away from explanation and drill-oriented instructions toward hands-on, active learning methods, as emphasised in the new national standards of Nebraska frameworks, were conducted (Wise, Spiegel, and Bruning, 1999). These standards include: incorporation of constructivist teaching and learning techniques reflecting changes in learning theory and focusing on student-centred learning and real-life applications of concepts, solving problems, and independent learning. The goals of the workshops were to:

- 1) raise understanding of mathematics and science standards,
- 2) create an active learning environment,
- 3) use technology in the classroom,
- 4) integrate mathematics and science,
- 5) increase multicultural awareness,
- 6) improve communication of teachers, and
- 7) provide better assessment.

The results of this study provided evidence that teachers can put concepts and strategies learned in the workshops into practice in their teaching. For example, regarding Goal 1: understanding mathematics and science standards, the majority of teachers articulated the specific standards to which their lessons or teaching strategies applied. Their lessons, for instance, related to the standards by allowing pupils to solve problems by co-operatively working together using a hands-on approach.

### **3:10 Conclusion**

In conclusion, evaluative research is very important in developing teacher education programmes, which promote the quality of practice. There are many purposes for conducting evaluative studies but the most important purpose is to improve the quality of the programme under investigation. In any evaluation study, a systematic evaluation framework is essential.



It is also concluded that teacher preparation programmes, to be effective in educating prospective teachers, must go hand in hand with school reform. Any reform in the school system should correspond with a reform in the teacher education system. It must equip the new generation of teachers with knowledge and skills they need to bring about a change in schools.

Based on what has been mentioned above, to improve the science teacher education programme at the Omani Colleges of Education, an evaluative research is crucial. The improvement of this programme ought to be guided and accomplished by the utilisation of the results of this research. This evaluative study assesses the student teachers' competencies as required to teach in the Omani reformed schools such as the skills of teaching, assessment and evaluation and using the problem-solving approach. This research also investigates the importance and effectiveness of the pedagogical courses and practicum aspects.

## CHAPTER FOUR: THE METHODOLOGY

# CHAPTER FOUR: THE METHODOLOGY

## 4:1 Introduction

Research is one of the most important and successful means that we can use to discover truth (Cohen & Manion, 1994 and Mouly, 1978). Howard and Sharp (quoted by Bell, 1993) define the term *research* as:

*seeking through methodical processes to add to one's own body of knowledge and, hopefully, to that of others, by the discovery of non-trivial facts and insights (p. 2).*

Mouly (1978) gives a more comprehensive definition for research:

*the process of arriving at dependable solutions to problems through the planned and systematic collection, analysis, and interpretation of data. It is a most important tool for advancing knowledge, for promoting progress, and for enabling man to relate more effectively to his environment, to accomplish his purpose, and to solve his conflicts (p. 12).*

As well as highlighting the value of research, Mouly (Ibid.) also indicates that the process of carrying out research is derived by a stimulus or a purpose such as a problem to be solved or validation or verification of other research.

Thus, research has procedures and techniques (methodology) that are designed to answer its questions. This chapter deals with the techniques and procedures that were used in this research. It describes and analyses the data collection approach, sampling, instruments and the framework of the analysis and ethical considerations.

## 4:2 Data Collection

A combination of qualitative and quantitative tools were used to meet the aims of this study. Evaluation research in education commonly uses qualitative and quantitative methods (Audah & Malkawi, 1992; Halim, 1997; Spiegel, 1998; Pierce, 1991; Taib, 1997



& Veenman, 1995). As Hitchcock and Hughes (1995) and Kuipers and Richardson (1999) argue, evaluation studies can use a mixture of quantitative and qualitative approaches. The qualitative approach is described as being subjective, anti-positivist, interpretative, naturalistic and constructive whereas the quantitative approach is objective, positivist, normative and experimental (Cohen & Manion, 1994; Creswell, 1994; & Lincoln & Guba, 1985). Creswell (1994) highlights the difference between qualitative and quantitative study by saying that:

*This study (qualitative) is defined as an inquiry of understanding a social and human problem, based on building a complex, holistic picture, formed with words, reporting detailed views of informants, and conducted in a natural setting. Alternatively a quantitative study ... is an inquiry into a social or human problem, based on testing a theory composed of variables, measured with numbers, and analyzed with statistical procedures, in order to determine whether the predictive generalizations of the theory hold true (pp. 1-2).*

Although the aims of the two approaches are to investigate social and human problems, the procedures are quite different. In qualitative study, researchers start by collecting data and from these data they try to construct and induce a theory that explains the phenomena under study. On the other hand, quantitative researchers work deductively from a theory with different variables and they try to test the relationships between these variables. The research is thus carried out to test and validate the theory and to measure the extent to which it can be generalisable. In Creswell's (1994) view:

*One approaches a quantitative methodology by using a deductive form of logic wherein theories and hypotheses are tested in a cause-and effect order. Concepts, variables and hypotheses are chosen before the study begins and remain fixed throughout the study... The intent of the study is to develop generalisations that contribute to the theory and that to enable one to better predict, explain, and understand some phenomena. Alternatively, in a qualitative methodology inductive logic prevails. Categories emerge from informations, rather than identify a priori by the researcher. This emergence provides rich "context-bound" information leading to patterns or theories that help explain phenomena (p. 7).*

In addition, the type of data collected by the two approaches differs in nature as well as the number of participants in a given study. While facts can be captured in numeric forms,

feelings cannot be. So, it is not feasible to include a large number of participants in a qualitative study as in quantitative research. The difference between the two methodologies relative to the nature of the data collected and sample size, as Blaxter, *et al.* (1996) state that

*Quantitative research is, as the term suggests, concerned with the collection and analysis of data in numeric form. It tends to emphasise a relatively large-scale and representative set of data, and is often ... presented and perceived as being about the gathering of 'facts'. Qualitative research, on the other hand, is concerned with collecting and analysing information in as many forms, chiefly non-numeric, as possible, smaller numbers of instances or examples which are seen as being interesting and illuminating, and aims to achieve 'depth' rather than breadth (p. 60).*

Furthermore, quantitative research differs from qualitative in the researchers' value and bias. Quantitative researchers tend to keep their values out of the study. They just report 'facts' and argue closely from the evidence collected in the study. On the other hand, qualitative research is "value-laden" and "value-bound" in nature and, therefore, researchers' value and biases are reported as well as the value nature of the information gathered from the field (Borg & Gall, 1989 & Creswell, 1994).

In teacher education research various methods can be utilised to solve the difficulties of teacher education as Jong and Brinkman (1999) say:

*... educational research can be viewed as helpful in resolving the difficulties of teacher education. Various research approaches can be used, qualitative and quantitative (p. 6).*

The assumption that underpinned the decision to use a mixture of qualitative and quantitative methods in this research was that one approach might not provide a complete picture of the phenomena. Therefore, the use of more than one data collection approach in this study was used to combine strengths and correct some of the deficiencies in any one source of data. Padgett (1998) indicates that there are strengths and weaknesses of any single data collection strategy. Building balances into a design through multiple data



collections is called “*triangulation*”. According to Maxwell (1998), the purpose of triangulation is:

*to reduce the risk that your conclusions will reflect only systematic biases or limitations of a specific method, and allows you to gain a better assessment of the validity and generality of the explanation that you develop (pp. 88-89).*

Denzin (1978) also recommends triangulation because:

*no single method ever adequately solves the problem of rival causal factors. ...Because each methods reveals different aspects of empirical reality, multiple methods of observation must be employed (p.28).*

He insists that “*multiple methods should be used in every investigation*” (p.28). Padgett (1998) argues that the triangle is the strongest of all geometric shapes, and triangulated evaluation designs are aimed at increasing the strength of an evaluation. Many of the best social work studies combine both qualitative and quantitative research tools (Epstein, 1988). Cohen and Manion (1994: 233) indicate that triangular techniques in the social sciences explain more fully the richness and complexity of human behaviour by studying it from more than one standpoint by making use of both quantitative and qualitative data. Indeed, it secures an in-depth understanding of the phenomena under investigation. Denzin (1978) has identified four basic types of triangulation:

- *data triangulation- the use of a variety of data sources in a study, for example, interviewing people in different status positions or with different points of views;*
- *investigator triangulation- the use of several different evaluators or social scientists;*
- *theory triangulation- the use of multiple perspectives to interpret a single set of data; and*
- *methodological triangulation- the use of multiple methods to study a single problem or program, such as interviews, observations, questionnaires and documents (p. 60)*

In the methodology design of this study, in order to give a clear picture about the science teacher programmes in the Colleges of Education in Oman, triangulation was addressed



through data triangulation, theory triangulation and methodological triangulation. The sources of data included: student teachers, newly qualified teachers and teacher educators. A range of data collecting tools was utilised by using questionnaires, interviews and document examination. Multiple perspectives were used to interpret the results of the study.

## **4:3 Research Tools:**

### **4:3:1 The Questionnaires:**

The aim of the questionnaires was to provide an initial overall evaluation of the pre-service science teacher education programme at the Colleges of Education. The questionnaires were utilised to gather information from participants. This was in order to assess the science teachers' competencies and to explore the importance, and effectiveness of the pedagogical, and practicum aspects of the teacher preparation programme in preparing science teachers. Questionnaires have been used in evaluating teacher education programmes (Al Barwani & Ibrahim, 1997; Al Salmi, 1996; Boulianne & Weston, 1987 and San, 1999). Ferber (cited in May, 1997) defines a questionnaire as

*A method of gathering information from a number of individuals, a 'sample', in order to learn something about the larger population from which the sample is drawn (p. 85).*

Mindel and McDonald (1988) state three uses of the questionnaire:

- *as an exploratory method when there is little known about the research questions under consideration;*
- *to describe certain populations when we need an accurate picture of who we are dealing with; and*
- *to explain why a certain population does whatever it does that is interest to us (p. 301).*

Questionnaires are classified into two types: those which are designed for self-completion in which the respondents complete the questionnaires themselves, and those which designed for assisted completion wherein the researcher asks the questions and fills in the

questionnaire him/her self (Robson, 1993). In this study, the questionnaires were self-completed because of the large sample size.

Questionnaires do have some limitations, such as: the lack of opportunity to clarify issues; superficiality of information; the response to a question may be influenced by the response to other questions and the problem of non-return of questionnaires (Edwards & Talbot, 1994 & Kumar, 1996). These limitations were minimised in this research by attention to the design of questionnaire, pilot study and implementation.

#### 4:3:1:1 The Design of Questionnaire

The questionnaire used in this research was designed and tailored to relate specifically to the teachers' skills that are required by the Ministry of Education, Oman. It focuses on the teachers' competencies needed in the Reformed General Education (the Basic Education, Stage Two). These skills are the skills of teaching science, the skills of assessment and evaluation and the skills of using problem-solving methods in teaching science. Questions about the importance and effectiveness of pedagogical and practicum courses in the science teacher programme at the Omani Colleges of Education are also essential parts of the questionnaire. Various sources were used to develop the questionnaire. Table 4:1 gives an overview of these sources.

**Table 4-1 Sources from which the questionnaire developed**

<b>Questionnaire Sections</b>	<b>Sources</b>
Section (2): the teachers' skills of teaching science	Adopted from the documents of the Ministry of Education (Ministry of Education, 1995 & 1999a)
Section (3): the teacher' skills of assessment and evaluation	Developed out from the documents of the Ministry of Education (Ministry of Education, 1995; 1999a & 1999b)
Section (4): the teacher' skills of problem solving approach	Derived from Casey and Howson (1993)
Section (5): pedagogical courses	Adopted from the documents of the Ministry of Higher Education (Ministry of Higher Education, 1996 & 1998a)
Section (6): practicum aspects	Adopted from the documents of the Ministry of Higher Education (Ministry of Higher Education, 1996 & 1998b)
The open-ended questions for each section	Derived from the literature review that is related to the evaluation of teacher programmes and from the above sources



In addition, previous studies, unpublished doctoral dissertations and other literature concerning the evaluation of pre-service and in-service teacher programmes informed the design of the questionnaire, its categories and the design of the open-ended questions (e.g. Al Salmi, 1996; Ariza & Gomeza, 1992; Boulianne & Weston, 1987; Kennedy, 1996; Mifsud, 1996; San, 1999 and Taib, 1997).

The questionnaire contains both descriptive and evaluative questions. The format of the closed questions is a Likert 5-point scale: (1= not competent and 5= competent), (1= not important and 5= important) and (1= not effective and 5= effective) (Likert, 1932). The open-ended questions sought in-depth some qualitative data to consolidate and elicit the closed questions. These questions were also to attempt to draw out other factors that might have had an impact on the training process.

The questionnaire was translated into Arabic. The procedures of translation of the questionnaire from English to Arabic are listed below:

1. the questionnaire was approved by the researcher's supervisors;
2. a first translation was done by the investigator and a second one by the head of the English Department at the College of Education, Nizwa;
3. copies of these translations were given to an Arabic language expert at the College of Education, Nizwa, to compare the two translations; and
4. the final version of the Arabic questionnaire and English one were submitted to a linguistics expert who graduated from the United Kingdom and who has an educational background, to compare the two versions.

The questionnaire was approved by experts from the College of Education, Nizwa and the Omani Ministry of Education. It was field tested with a group of student teachers. A pilot study of the questionnaire was conducted after getting a letter of authorisation from the Ministry of Higher Education in March 2000. May (1997) indicates that a questionnaire



needs to be piloted on a subsample before it is conducted with the full sample. Kidder (cited in May, 1997) states that piloting aims to discover how the survey:

*works and whether changes are necessary before the start of the full scale study. The pretest provides a means of catching and solving unforeseen problems in the administration of the questionnaire, such as the phrasing and sequence of questions or its length. It may also indicate the need for additional questions or the elimination of others (P.93).*

Thus, the Arabic translation was administered to a subsample of student teachers who were in the final semester of their study at the College of Education, Nizwa. Comments were obtained from the student teachers and considered. In addition, four teacher educators in the Educational Studies Departments at the Nizwa's College discussed these comments in a meeting. The questionnaire also was commented on by other teacher educators. It was revised in the light of the comments of student teachers and teacher educators.

The final version of the questionnaire, which was applied to student teachers (Appendix 2), was composed of 91 items in six sections. The questionnaire, which was applied to teacher educators (Appendix 3), was modified from the student teachers' questionnaire and it was composed of 89 items. Table 4:2 gives an overview of the number of questions for each section.

**Table 4-2 The sections of the student science teachers' and educators' questionnaires**

Questionnaire Sections	Research questions	No. of Questions	
		Student teachers	Educators
General Information		5	4
Teaching Skills	Q1	22	21
Assessments and Evaluation skills	Q2	12	12
Problem-solving skills	Q3	16	16
Pedagogical Courses	Q4	14	14
Practicum Aspects	Q5	20	20
General questions	General	2	2
<b>Total</b>		<b>91</b>	<b>89</b>

#### 4:3:1:2 The Conducting of Questionnaire and the participants:

The questionnaires were conducted with all the student science teachers in the final semester of the final year of their study and all the teacher educators in the Departments of Educational Studies in all the six colleges: Nizwa, Ibri, Suhar, Restaq, Sur and Salalah in the academic year 2000/2001 in Oman.

The researcher was available in the first four colleges when the student teachers were completing the questionnaires. Approximately 5 minutes were spent with each group to explain the purpose of the questionnaires and how to fill them in and respond to any question. The availability of the researcher yielded almost a hundred per cent correct completion and a 92.4% per cent return. 7.6% of student teachers in these colleges were absent when the questionnaires were conducted.

For the two other colleges: Sur and Salalah, questionnaires were posted through the General Directorate of Colleges. This was done, because of the great distance of these colleges. The total sample of student teachers represents about 81% of the study population. Tables 4:3 shows the figures of population and samples of student teachers.

**Table 4-3 Number of the population and samples of student teachers**

Name of Colleges	Area of Specialisation										Total	
	Physics/ Computer		Physics/ Mathematics		Physics/ Chemistry		Chemistry/ Physics		Chemistry/ Biology		P	S
	P	S	P	S	P	S	P	S	P	S		
Nizwa	33	30	31	30							64	60
Ibri							54	48			54	48
Suhar					39	35	32	30			71	65
Ristaq					35	34					35	34
Sur									49	29	49	29
Salalah			29	13	34	22					63	35
<b>Total</b>	<b>33</b>	<b>30</b>	<b>60</b>	<b>43</b>	<b>108</b>	<b>91</b>	<b>86</b>	<b>78</b>	<b>49</b>	<b>29</b>	<b>336</b>	<b>271</b>

P: Population, S: Sample



The questionnaires for educators were sent through the General Directorate of College attached with official letters to the deans of colleges. The sample represents 58% of the whole population. Table 4:4 shows the figures of population and samples of the educators.

**Table 4-4 The population and samples of the educators**

Area of specialisation	The name of colleges												Total	
	Nizwa		Salalah		Ibri		Sur		Suhar		Restaq			
	P	S	P	S	P	S	P	S	P	S	P	S	P	S
Curriculum & teaching methods	16	10	16	10	16	7	13	6	16	8	18	8	95	49
Psychology	5	4	8	6	10	6	8	4	8	5	9	5	48	30
Educational administration	5	5	6	6	7	4	7	3	6	4	8	4	39	26
Total	26	19	30	22	33	17	28	13	30	17	35	17	182	105

P: population, S: sample

### 4:3:2 Interviews

Interviews were also used to collect data to help answer the research questions to validate and clarify data collected by the other research methods employed. The interviews were conducted with sub-samples of student science teachers, and teacher educators and with a small sample of newly qualified teachers. Gochros (1988) and Kumar (1996) indicate that interviewing is at the core of social work practice and it is the most commonly used method of collecting information from people for research studies. Holstein and Gubrium (1999: p. 103) also state that interviews are a way of gathering empirical data about the social world in special forms of conversation. As a research method, interviews can serve different purposes. Cohen and Manion (1994) identify three main purposes of interviewing. These purposes are: 1) as a principal procedure for gathering data for the research objectives; 2) as a means of testing hypotheses, suggesting new hypotheses or explaining relationships between variables and 3) as a validating instrument confirming and verifying data collected by other research methods (pp. 272-273). The interview has a wide variety of forms and a multiplicity of uses. The authors classify the most common types of interviewing into structured, semistructured and unstructured. The interviews are



also categorised into a one-to-one interview and focused group interview (Cohen & Manion, 1994; Fontana & Frey, 1994; Padgett, 1998 & May, 1997).

Interviews have increasingly been used in qualitative evaluation studies (e.g. Cepni, 1993; Greene, *et al.*, 1987; Gustafson & Rowell, 1995; Halim, 1997 and Taib, 1997 and Veenman *et al.*, 1995).

The interview has certain advantages. Gochros (1988) summarises them as follows:

*The advantages are primarily related to naturalness and spontaneity, flexibility, control of environment, possible serendipitous information, and high response rate (P.297).*

The most important advantage of the interviews is flexibility. Mouly (1978) explains the fruit of being flexible by saying that

*The primary advantage of interview over questionnaire is its flexibility, which permits the investigator to pursue leads that appear fruitful, to encourage elaboration of points that the respondent that has not made clear or has partially avoided, and to clarify questions that the respondent has apparently misunderstood (pp. 202).*

In addition, compared with written forms of enquiry such as questionnaires, interviews allow the researchers to be close to their subjects and this, in turn, allows them to utilise body language and facial expressions and other forms of non-verbal cues in interpreting and clarifying the responses provided by the participants (Robson, 1993).

Interviews, however, are not problem-free. They have some disadvantages over other data-collecting tools. Gochros (1988) summarises them as follows:

*The disadvantages are related to time and expense, interview intensity, inaccessibility to respondents, loss of anonymity, interviewer distortion, and interviewer influence (P.297).*

Cohen and Manion (1994) say the most important drawbacks of the interviews are the “bias” and “subjectivity” of the interviewer. This stems partly from the flexibility of the interview. This flexibility creates a situation into which the researcher may project his or her personality and therefore influences the responses he or she receives (Mouly, 1987). Thus, the interviewer might lead or encourage the interviewees to provide answers that support his or her “preconceived notions” (Cohen and Manion, 1994) rather than answers that the respondents think are right.

On the other hand, bias can be caused by the respondents themselves. In this regard, interviewees might provide answers which are far away from the truth just to please the interviewer. Thus, what they say does not necessarily accord with what they do or believe.

Sanders and Pinhey, quoted by Al Hammami (1999) in this regard say:

*people tell others what they think others want to hear or what they want them to know. In other words, people say one thing and do something else. What they tell researchers is even less candid and accurate, for outsiders are considered as outside snoops to whom one does not owe loyalty or honesty (p. 56).*

In summary, bias is a natural phenomenon caused by the two parts of the interview; interviewer and interviewees.

The other disadvantage that relates to the feasibility of interviews is that they are time-consuming especially when it comes to the stage of transcribing and analysing data (Cohen and Manion, 1994 and Robson, 1993). In addition, unlike questionnaires that can be posted to the subjects, interviews require seeking an acceptance and making appointments with the intended participants who might not be readily available and therefore, the researcher has to adjust his agenda according to the interviewee’s availability. Furthermore, one has to mention the time and effort is spent on travelling from one place to another to interview participants.



However, in this research, these disadvantages were overcome by preparing carefully the interview schedules, setting out the structure, and sequencing of specific items that were asked. The interview schedules were given also to the participants beforehand, this, gave them a chance to prepare and therefore, helped prevent problems of misconception.

In addition, the researcher tried to be as objective as possible during the interviews. This was done by avoiding expression of personal opinions about certain issues or making facial expressions, and any other subtle cues. An informed interviewer can identify and distinguish what is true and what is false from the respondent's speech. The researcher has experience of working in one of the colleges and this enabled him to be close to the situation under study. Finally, the letter of confidentiality, which was sent to the interviewees beforehand along side the interview schedule, helped prevent many of the aforementioned problems.

Taking into account the theoretical framework of this study and the research questions, two semistructured interview schedules were designed. One was conducted with student science teachers and newly qualified teachers whereas the other was conducted with teacher educators. Two sorts of semistructured interviews, which were conducted with student teachers and teachers, were used, one-to-one interviews and group interviews. The semistructured interviews helped gain clarification and deeper explanation from the interviewees and this gave better understanding of the effectiveness of the teacher programme in preparing science teachers. According to Borg and Gall (1989), semistructured interviews provide a desirable combination of objectivity and depth. In addition, they can permit gathering of valuable data that could not be obtained by another tool.



Although the semistructured interview has some drawbacks, such as the coding and analysis of the data, it has a lot of advantages of flexibility. In this research, the researcher utilised the advantages of the semistructured interviews; i. e. to probe the answers and thus entered into a dialogue with the interviewees by adding some questions as necessary. Furthermore, the schedule guides were flexible enough for the researcher to collect data on unexpected dimensions of the topic.

#### **4:3:2:1 The Preparation of the Interviews**

The framework of the study helped in designing the interview schedules. The interview questions were linked to the questionnaire questions. The following procedures were followed to develop the interview questions:

1. the research questions were formed;
2. literature on the use of interviews as a tool for evaluating teacher education programmes was reviewed;
3. a group of questions were designed for each research question;
4. it was ensure that those interview questions match the research questions and the questionnaire statements;
5. several drafts of the questions were prepared and discussed with the researcher's supervisors;
6. the final versions of the interview schedules were approved by the researcher's supervisors;
7. the final schedules were translated into Arabic.

Appendix 4 gives an overview of the schedule of the student teachers and teachers' interview and appendix 5 gives an overview of the schedule of the teacher educators' interview.

#### **4:3:2:2 The Conducting of Interviews**

Sub-samples of student teachers and teacher educators were interviewed. In addition, some newly qualified teachers were also interviewed. Seaberg (1988) defines a sample as

*a small portion of the total set of objectives, events, or persons which together comprise the subject of our study. The total set from which the individuals or units of the study are chosen is referred to as a population (p. 240).*

It is very important that the sample represents the characteristics of the population (May, 1997). Because one cannot investigate everything and everyone, sampling strategies with clear rationales are needed (Padgett, 1998). Maxwell (1998) identifies four purposes served by sampling:

- to achieve representativeness or typicality of the settings, individuals, or activities selected;
- to capture adequately the heterogeneity in the population;
- to allow for the examination of cases that are critical for the theories the study began with, or that have subsequently been developed; and
- to establish particular comparisons to illuminate the reasons for differences between settings or individuals (pp. 87-88).

However, qualitative research relies on purposeful sampling in which the samples are carefully selected for the important information they can provide (Maxwell, 1998). Patton (1990) states that the purpose of purposeful sampling is “*to select information-rich cases whose study will illuminate the questions under study*” (p. 169).

In this research, interviews were conducted in two representative colleges, one male and one female. There was no need to conduct interviews in all the colleges for the following reasons:

- all the six colleges are run and supervised by the same ministry, the Ministry of Higher Education;
- all colleges follow the same system, i.e. the Credit Hour System;
- all curriculum materials and syllabi are the same;
- all colleges have similar resources and facilities; and

- all student teachers apply the practicum in “the general education schools” which are run and supervised by the Ministry of Education.

Although the colleges are located in different regions in the country, students in each college represent almost all the country. In short, the colleges are a homogenous and analogous entity.

Before conducting the interviews, letters of authorisation from the Ministry of Higher Education and the Ministry of Education were obtained. This was to allow the researcher to conduct the research in the sites determined; i.e. the Colleges of Education and the schools. Also, letters were sent to all the participants explaining to them the purpose of the interviews and seeking their permission to tape-record the interviews. The interview schedules were attached to these letters, so that the participants had time to think and prepare for the interviews.

All the interviews were recorded on audio tape except for two educators. Using the tape-recorder helped the researcher to concentrate on the process of the interview. The interviewees always had opportunities to speak at the end of the interviews about anything else that they felt to be important or that they wanted to add.

There were some problems that arose during the interview processes. For example, the researcher intended to conduct individual interviews with the newly qualified teachers, but the female teachers did not agree to be interviewed individually. Thus, this problem was solved by interviewing them in a group. Another problem was related to the use of the tape recorder. Two educators refused to record the interviews. The reason, according to them, was “they do not see there is a need to use the tape recorder”. The importance and purpose of using a tape recorder were explained to them. They were told that what they say would



be highly confidential, but they insisted that they did not want to be recorded and one of them said, “*do not worry, I am going to answer all the interview questions but I am not going to be tape-recorded*”. Thus, the researcher had to take notes during these interviews instead of recording them.

#### **4:3:2:3 Interviewees**

This study employed two types of semistructured interviews. Besides one-to-one interviews conducted with the teacher educators and the newly qualified male teachers, there were also group interviews conducted with student teachers and newly qualified female teachers. The reason behind using the group interviews was because this kind of interview shares some characteristics of real-life informal interactions and therefore they were used here on the belief that the participants would express their views freely. In addition, these participants could share some interests. Furthermore, in the group interview, according to Patton (1990), rich data can be obtained because the respondents can provide additional comments from their original responses when they hear the responses of their fellow participants. This in turn, allowed the researcher to test consistency in respondents’ answers to the questions and to collect high quality data because respondents “*tend to provide checks and balances on each other that weed out false or extreme views*” (Patton, 1990: p.336).

The total number of interviewees was 36: 17 interviewees from the student teachers and newly qualified teachers and 19 from the Educational Studies Department. Table 4:5 gives an overview of the numbers that were interviewed.

**Table 4-5 The numbers of the group and one-to-one interviewees**

Interviewees	Types of Interviews	Number
<b>Educators</b>		<b>19</b>
The Curriculum and Teaching Methods Unit	One-to-one	10
The Psychology Unit	One-to-one	4
The Administration and Educational foundation Unit	One-to-one	5
<b>Student teachers and teachers</b>		<b>17</b>
The male student teachers	Group interviews (2 groups of 3=6)	6
The female student teachers	Group interviews (2 groups of 3=6)	6
The newly qualified male teachers	One-to-one	2
The newly qualified female teachers	Group interview (1 group of 3=3)	3
<b>The total of the interviewees</b>		<b>36</b>

### 4:3:3 Use of Documents

Documents are very important sources of information in research (Manning and Cullum-Swan, 1994; Padgett, 1998 and Punch, 1998). The reasons behind using documents are stated by Robson (1993) who says:

*Letters and notices, school curricula and timetables, office memos, graffiti, litter and other ephemera may sometimes speak louder than a response to an interview question, or tell us about something we were not in a position to observe (p. 187).*

For this reason, it was crucial for this research to examine the related documents for verifying the validity of results that emerged from the questionnaires and interviews, e.g. repetitions of course content. The following documents were used:

- the main college's document: to identify the goals and competencies of the colleges (Ministry of Higher Education, 1996);
- the syllabi of educational courses e.g. the Science Teaching Methods, Comparative Educational Systems, School Management, etc (Ministry of Higher Education, 1998a),
- practicum aspects (Ministry of Higher Education, 1998b) and
- assessment form of the practicum (Ministry of Higher Education, 2000).

### 4:3:4 Summary of the Research Methods:

The research tools used in this study were questionnaires, interviews and examination of documents. The questionnaires were conducted with student science teachers and teacher educators. The interviews were conducted with student science teachers, newly qualified teachers and teacher educators. Table 4:6 gives an overview of these methods and participants.

**Table 4-6 Summary of the research tools and participants**

The methods	The participants			
	Student teachers	Newly qualified teachers	Teacher educators	Document of the M. of Education and the M. of Higher Education
Questionnaires	*		*	
Interviews	*	*	*	
Use of Documents				*

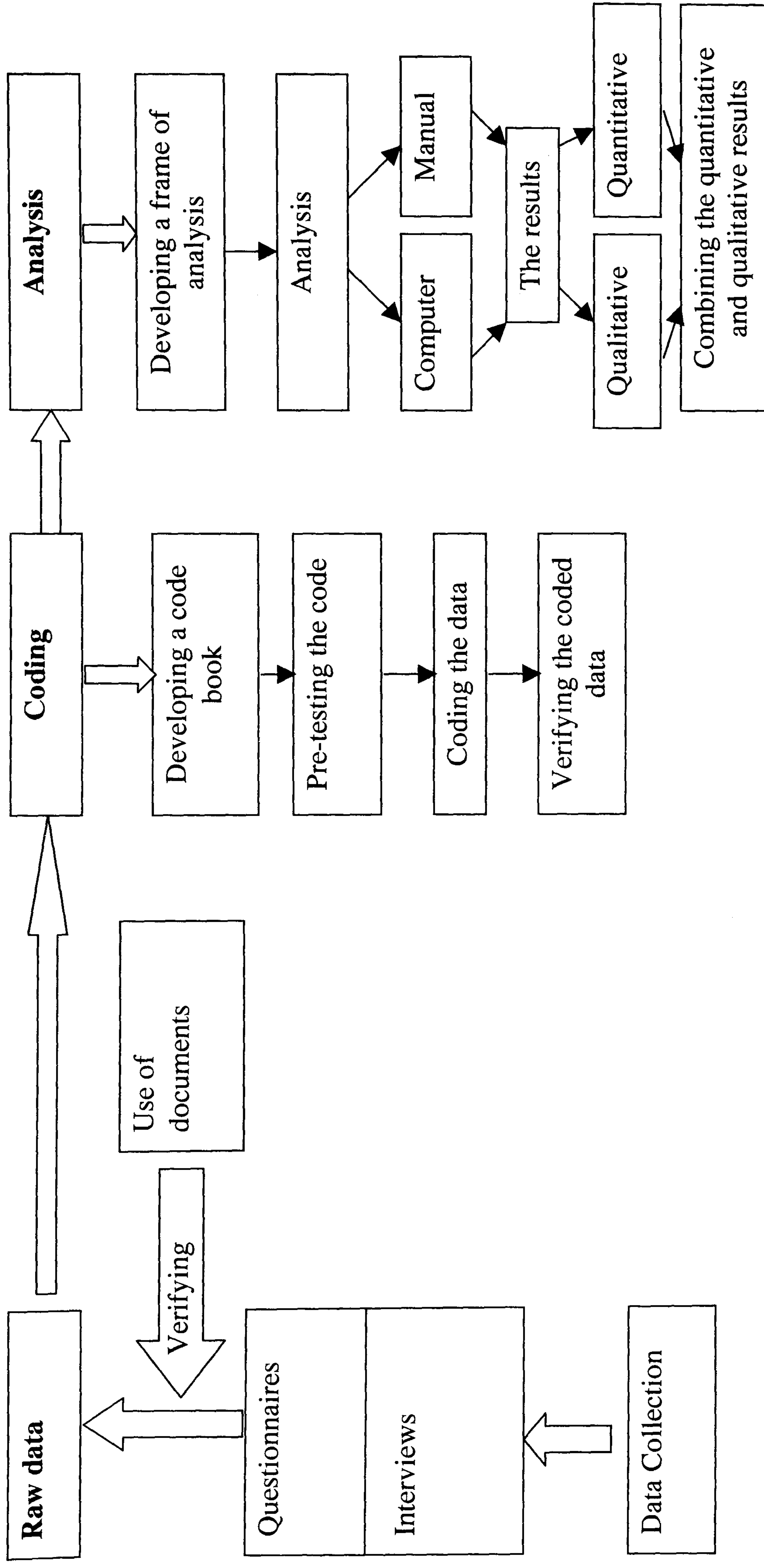
\*: the tool was conducted

### 4:4 Data Analysis Framework

The information collected by the study tools was analysed in order to answer the research questions. A series of steps was followed. This part of this chapter gives an overview of these steps. A framework of data analysis was developed from Kumar (1996) to give an overview of data processing analysis of this study. This framework is illustrated in Figure (4:1). The statistical procedures are addressed in the analysis chapter.



**Figure 4:1: The framework of the data analysis**



This Figure is based on the framework of this study. It was developed from Kumar (1996).

A careful analysis was carried out so as to elicit the extent to which the science teacher education programme was effective in preparing science teachers. Coded data from the questionnaires (close-ended questions) was input into a computer by using the Statistical Package for the Social Sciences (SPSS)<sup>\</sup>. A numerical value to each of five response categories for the following was coded:

- Student teachers' competence: (not competent =1;competent =5);
- The importance of the pedagogical course and practical aspects (not important =1; important =5) and
- The effectiveness of pedagogical courses and practicum aspects (not effective=1; effective =5).

This quantitative data were analysed according to mean ratings, and ranking and statistical tests (Al salmi, 1996; Boulianne & Weston, 1987; Mifsud, 1996 and San, 1999). The mean for each response gave an indication of the strength and range of the student teachers' competence and the importance and effectiveness of the pedagogical courses and practicum components with respect to each statement. Ranking of the means showed issues of greater or lesser statements for each section of the student teachers competencies. Statistical tests were also used to examine the differences between the importance and effectiveness of the pedagogical and practicum courses and to compare between the study variables. These tests are addressed in chapter 5 and 6.

For the purpose of presenting the descriptive results of the student teachers' competencies, the importance and effectiveness of the educational courses and the practicum aspects, the five Likert scale was converted into a three-category scale (Al Salmi, 1996). This was to make the analysis and presentation of the statistical results more reliable, easier, more describable and more understandable.

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<sup>\</sup> SPSS is one of the most popular statistical packages, and can perform highly complex data manipulation and analysis with simple instructions (Punch, 1998: 134).

Likert scale (5 points)	1	2	3	4	5
Converted 3 point scale	1.00 to 2.49		2.50 to 3.49		3.50 to 5.00
Interpretation	Not competent, not important, not effective		Average		Competent, important, effective

Qualitative analysis was employed to analyse the results of the interviews and the open-ended questions of questionnaires. Grids and tables were prepared to analyse the subjects' responses. Bullock and Scott (1992) indicate that preparing a grid to group the results is helpful to gain a particular focus. The results were grouped into meaningful categories and subcategories to identify the commonalities in order to categorise comments on particular aspects. The analysis procedures were organised into the following steps:

- all responses to each question were listed and accumulated;
- multiple drafts were made and remade as data gathering and analysis proceeded;
- groups for each question were established;
- the groups of responses were organised by categories and subcategories;
- the final categories and subcategories were translated from Arabic to English;
- counts for absolute frequency and relative frequency were applied;
- these steps were repeated to verify the reliability of the data analysed.

In addition, a colleague coded some questionnaires and interviews independently to check for consistency.

Some numbers and frequencies were reported in the analysis of the qualitative results as Padgett (1998) identifies that qualitative researchers might also report numbers, percentages or frequencies from the analysis of the findings. Microsoft Excel was used to calculate the percentages of each category and subcategory.



In addition, it is also important to say here that quotations from interviews were used in reporting the results of this thesis. These quotations were translations from spoken Arabic to English. Therefore, the occurrence of grammatical errors is inevitable. In these quotations, a coding system was used to refer to participants. The codes “ST”, “NQT”, “EC”, “EP”, and “EA” refer to student teacher, newly qualified teacher, educator from the curriculum unit, educator from psychology unit and educator from administration unit respectively. The number following those codes refers to an individual participant. The results of the questionnaires and interviews were verified by document examination.

The data were displayed in tables. Punch (1998) and Kumar (1996) say that data display is an essential part of the data analysis. The main purpose of using data display techniques was to make finding of this research clear and easily understood, and to give a good representation of the spread of responses.

#### **4:5 The Ethics of this Research**

Ethics in research should be an integral part of the research planning and implementation process (Mertens, 1998). Ethical issues might arise at any stage of the research process; i.e. designing of study methods, data collection, analysis, or at the stage of reporting the research results (Blaxter, 1996). Thus, any research project is liable to raise ethical issues especially when people are involved as research subjects. Therefore, it is very important for the researcher to be well-informed about these issues, so, that s/he can respond to them and overcome problems associated with them.

Given (cited in Cohen and Manion, 1994) defines ethics as

*a matter of principled sensitivity to the rights of others. Being ethical limits the choices we can make in the pursuit of truth. Ethics say that while truth is*

*good, respect of human dignity is better, even if, in the extreme case, the respect of human nature leaves one ignorant of human nature (p. 359).*

*The National Commission for the Protection of Human Subjects and Biomedical and Behavioral Research* (cited in Mertens, 1998: 24) identified three ethical principles and six norms that should guide the research. The three ethical principles include the following:

- **Beneficence:** maximising good outcomes for science, humanity, and the individual research participants and minimising or avoiding unnecessary risk, harm or wrong.
- **Respect:** treating people with respect and courtesy, including those who are not autonomous (e.g., small children, people who have mental retardation or senility).
- **Justice:** ensuring that those who bear the risk in the research are the ones who benefit from it; ensuring that the procedures are reasonable, non-exploitative, carefully considered, and carefully administered.

The six norms of research include the following:

- **Use of a valid research design:** faulty research is not useful to anyone and is not only a waste of time and money but cannot be conceived of as being ethical in that it does not contribute to the well-being of the participants.
- The researcher must be competent to conduct the research.
- **Consequences of the research must be identified:** procedures must respect privacy, ensure confidentiality, maximise benefits, and minimise risks.
- The sample selection must be appropriate for the purpose of the study, representative of the population to benefit from the study, and sufficient in number.
- The participants must agree to participate in the study through voluntary informed consent that is, without threat of undue inducement (voluntary), knowing what a reasonable person in the same situation would want to know before giving consent (informed), and explicitly agreeing to participate (consent).
- The researcher must inform the participants whether harm will be compensated.

Taking into account the mentioned Cohen and Manion's (1994) terminology and the above ethical principles and norms, the researcher had to maintain a balance between the *cost* and *benefit* of the research. The benefits of the research should not be at the expense of harming other people. As Cohen and Manion (1994) put it:



*the researchers have to strike a balance between the demands placed on them as professional scientists in pursuit of truth, and their subjects' rights and values potentially threatened by the research.*

The benefits of conducting this research and considering the study subjects' rights have been considered and balanced. Seeking acceptance, permission and informed consent have been thought about in designing this research. In addition, the confidentiality and anonymity of the participants were ensured.

Although the researcher works in the Ministry of Higher Education- the Ministry that runs the Colleges of Education where the research was conducted-, the researcher did not take acceptance to these colleges for granted, but obtained official letters to conduct the research from the concerned departments. The first letter was to say that he was sent by the Ministry for a scholarship to get his Ph.D from the University of Warwick (see appendix 8a). The letter stated the topic of the research. The other letter was from the General Directorate of the Colleges of Education instructing the Deans of the Colleges to provide assistance, to allow him to interview the required people, and to conduct the questionnaires with student science teachers in the final year and the educators in the Departments of the Educational Studies (see appendix 8b). Besides these two letters, covering letters were attached with all the questionnaires and letters were sent to each individual participant in the interviews explaining the purpose and value of the research and assuring them of the right to remain anonymous and that the information they would provide would be treated confidentially. Another letter was from the Ministry of Education to the Directorate General of Education in the Interior Region, followed by letters to the required science teachers in the schools (see appendix 8c). Furthermore, before each interview, the researcher explained the purpose of the research to the interviewees and explained the purpose of using a tape recorder.



There were a lot of signs that indicated that the researcher was well aware of the ethical issues and as a result he was accepted. For example, the participants wished him to accomplish his project with success. Some of them said that *“we really need such a study to express our opinions and to develop the teacher preparation programmes”*. While conducting of questionnaires and interviews, the researcher noticed that all the participants were very happy to participate in this research and they acknowledged him for this. For example, a student teacher said, *“nobody tried to listen to us, please write everything we have said in your report”*.

There were some factors that helped the researcher gain acceptance for conducting this research:

- cooperation and support from the Ministry of Higher Education, the Colleges of Education and the subjects; and the cooperation from the Ministry of Education;
- The researcher was fully sponsored by the Ministry of Higher Education to carry out this research; the research area was decided by the Ministry, which was seen as an important area to investigate in order to develop the science teacher education programmes;
- many of the study interviewees (teacher educators=19) are Ph.D. holders who had gone through this process and they know what research means in terms of the benefits for the research community and education;
- some of the newly qualified teachers were taught by the researcher; and
- he was known to almost all the participants (interviewees) and some of the student teachers.

Thus, the Ministry provided all the help that the researcher needed to accomplish this research. The participants were willing to co-operate, so, there was mutual interest in the research topic.

# CHAPTER FIVE: RESULTS

# **CHAPTER FIVE: RESULTS**

## **5:1 Introduction**

The results are divided into three main sections. The first section addresses student teachers' competencies. The second section reports the participants' evaluation of the importance and effectiveness of the pedagogical courses of the science teacher education programme. The third section covers the respondents' evaluation of the importance and the effectiveness of practicum aspects. In addition, results that emerged from the two last open-ended questions in the questionnaires and interviews and the effects of some variables on student teachers' competencies are presented at the end of this chapter.

The questionnaire was conducted with 271 student teachers and 105 educators. All the questionnaire data are presented in tables. The tables have the numbers of respondents to each question.

## **5:2 Student Teachers' Competencies**

The quantitative and qualitative results obtained from student teachers and educators' questionnaires are reported. Qualitative findings from the interviews of student teachers, educators and newly qualified teachers are also included. Document examination of the college's syllabi is used to verifying the findings from questionnaires and interviews. Student teachers' competencies of teaching, assessment and evaluation, and use of problem solving methods in teaching science are all considered.

### **5:2:1 Student Teachers' Competencies of Teaching**

The questionnaire elicited 20 closed responses from the student teachers and educators about their views on student teachers' abilities to use teaching competencies at the



completion of the initial training programme. Table 5-1 presents the descriptive statistics of these 20 responses. This includes: mean ratings of Likert scale responses and ranking.

**Table 5-1 Student teachers' competencies of teaching as viewed by student teachers and educators**

Teaching competencies	Student teachers	Educators	Mean Likert	Rank
Relate science with pupils' everyday life	3.74	3.36	3.55	3
Integrate science with other subjects	3.24	3.19	3.22	9
Relate science with the local environment	3.71	3.55	3.63	1
Recognise pupils' individual needs and provide appropriate activities for them	3.24	3.34	3.29	8
Take into account pupils' prior experience in the planning and teaching of lessons	3.23	3.17	3.20	10.5
Incorporate activities that are not included in science teacher guides	2.67	3.02	2.85	15
Ask questions that challenge pupils' thinking	3.08	3.02	3.05	14
Manage the learning environment to allow pupil-centred learning to take place	3.02	3.38	3.20	10.5
Encourage pupils to take initiative in their own learning	3.62	3.38	3.50	5
Develop pupils' communication skills through pupil-centred learning	3.35	3.36	3.36	6
Encourage pupils to develop process skills in science such as observing, classifying, communicating, predicting and experimenting	3.28	3.32	3.30	7
Guide pupils to use collaborative learning in science	3.07	3.26	3.17	12
Encourage pupils to learn and understand science by doing	3.69	3.38	3.54	4
Create opportunities for self-learning	3.30	2.96	3.13	13
Suggest homework that reinforces learning	3.88	3.26	3.57	2
Organise field work and visits	2.48	3.04	2.76	17
Organise science learning through games	2.17	2.72	2.45	20
Use information and communication technology	2.48	2.60	2.54	19
Use problem-solving methods	2.33	2.81	2.57	18
Use a variety of print and non-print resources such as kits, games, manipulative materials, computer software	2.67	2.87	2.77	16
<b>The overall means</b>	<b>3.11</b>	<b>3.12</b>	<b>3.12</b>	

5-point scale: 1=the lowest, 5=the highest. Student teachers (n) = 271, Educators (n) = 47.

The overall mean for the student teachers' teaching competencies was 3.12. The highest mean rating for these competencies for "*Relate science with the local environment*" was 3.63, which fell in the "*competent*" category. This item was followed by "*suggest homework that reinforces learning*", "*relate science with pupils' everyday life*", "*encourage pupils to learn and understand science by doing*", and "*encourage pupils to take initiative in their own learning*", which were rated between 3.57 to 3.50. These also fell in the "*competent*" category. For the remaining 15 competencies, all of them fell in the "*average*" category except one which fell in "*not competent*" category. The lowest mean

ratings were for the following items: “organise science learning through games”, “use ICT”, “use problem-solving methods”, “organise field work and visits” and “use a variety of print and non-print resources”. These were rated between 2.45 to 2.77.

### 5:2:1:1 ICT and Teaching Science

In the questionnaire, almost all student teachers (251/ 92.7%) responded to the question: “What are your views on the benefits of teaching science with ICT”? (Table 5: 2).

**Table 5-2 Student teachers’ views on the benefits of teaching science with ICT**

Categories	Subcategories	N	%
Their opinions on ICT benefits	Helping teacher to teach and deliver science effectively	38	15.1
	Facilitating pupils’ self learning	32	12.7
	Increasing pupils’ understanding	26	10.4
	Considering the individual differences between pupils	17	6.8
	Using the time available effectively	16	6.4
	Facilitating and simplifying the learning process	16	6.4
	Attracting pupils’ attention	14	5.6
	Involving pupils in learning positively	14	5.6
	Encouraging pupils to study	14	5.6
	Stimulating pupils’ desire (pleasure) to understand science	12	4.8
	Helping to find a new scientific knowledge	12	4.8
	Stimulating pupils’ motivation for learning	11	4.4
	Relating pupils with technology	11	4.4
	Developing pupils’ scientific skills	8	3.2
	Increasing the scientific vista (view)	6	2.4
How to use it?	Using computers in teaching science	13	5.2
	Using prepared scientific programs	7	2.8
	Searching scientific knowledge from the Internet	6	2.4
Training in the colleges	The training in the colleges to use ICT was insufficient	86	34.3
Others	ICT has become necessary in teaching and learning science	15	6.0
	It is supposed that the Ministry of Education started using ICT from long time	8	3.2
	ICT is very important for teaching and learning	7	2.8
	ICT is a developed teaching method	5	2.0

n: number of responses for each item, %: percentage = number of responses for each item/ total of respondents

Student teachers’ views on the benefits of using ICT are categorised in 15 statements. The highest-rated responses were:

- helping teacher to teach and deliver science effectively (n=38 / 15.1%);
- facilitating pupils’ self learning (n=32 / 12.7%) and
- increasing pupils’ understanding (n=26 / 10.4%).



However, few of them mentioned how to use ICT in teaching and learning science. The highest-rated use of it was “*Using computers*” (n=13/ 5.2%) whereas the lowest-rated use was “*Searching scientific knowledge from the Internet*” (n=6 / 2.4%).

Insufficient training in the colleges was highlighted in the answers to this question. 86 student teachers (34.3%) mentioned that the training in the colleges to use ICT was insufficient to meet their needs.

All student teachers and newly qualified teachers (n=17) also indicated in the interviews that ICT should be used in the teaching and learning of science due to its great benefits in the teaching and learning. However, all the interviewees mentioned that they had **not** been trained effectively to use ICT in learning and teaching of science. So, they did not have the required skills of using ICT in their teaching. For example, one of the female student teachers said:

*Although, science teachers should be knowledgeable in using ICT in teaching science, and they must be the people who most benefit from computers, really, we were not trained to use computer and the Internet in the teaching of science. So, we are not able to use ICT (ST7).*

A male student teacher also said that:

*ICT is very important for both teachers and pupils as it facilitates the teaching and learning processes. ICT must be the first teaching and learning method of science. Science teachers must have the abilities to use it but we have not been trained in the college (ST6).*

Student teachers in all the areas of science specialisation took one computer course named “Introduction to Computer”. Some of the interviewees (n=8) mentioned that this course was not sufficient and not linked to how to use the computer in teaching. Student teachers who were in the Physics/Computer specialisation took additional computer courses. In all these courses, student teachers were not provided with examples or demonstrations on how to use computers in teaching and learning of science. As a Physics/Computer teacher said:



*We took many courses in computer but they were not beneficial. For example, there was a lot of theoretical content about Pascal program, which was not related to the teaching of science. In all the computer courses, we did not study how to teach a lesson using a computer. So, we did not benefit from these courses (NQT2).*

Some interviewees (n=6) indicated that tutors did not use computers in their teaching. Tutors, in turn, did not encourage student teachers to use them. In an interview, when female student teachers were asked if the tutors encouraged them to use computers, they said: “no, no, no”. One of them continued saying that “*they (tutors) did not use computers and our low knowledge of using computer was by self learning. There was no supervision from our tutors*” (ST10).

In addition, many of the student teachers and teachers also mentioned that there were too few computers in the computer labs.

Some of the educators in the interviews mentioned that student teachers have some knowledge about ICT to some extent. However, the results reported that student teachers do not have skills to use it in teaching. As an educator states:

*Unfortunately, student teachers did not have the chance to use the skills of using ICT in college and schools. This was of course due to the limitation of resources (E1C).*

In the questionnaires, in answering a question related to “indicating recommendations that the respondents feel might contribute to improving the science teacher programme, 13 student teachers (14.9%) and 18 educators (30.5%) suggested “*using ICT in training student teachers*”. 15 student teachers (17.2%) and 14 educators (23.7%) recommended “*training student teachers to use ICT in their teaching of science*” (Table 5:33).

In the interviews, some educators (n=4) confirmed also that student teachers should be trained in the colleges to use ICT in their teaching. In addition, they mentioned the

importance of providing the colleges with enough multi-media labs, computer labs, films and programs that related to the teaching of science.

### 5:2:1:2 Experiential Learning Methods

In the questionnaire, 210 student teachers (77%) responded to the questions about the experiential learning methods (Table 5:3).

**Table 5-3 Student teachers' opinions on the new trends of the Ministry of Education in developing the teaching of science though experiential learning methods**

Categories	Subcategories	n	%
Their opinions; These methods:	Make pupils at the centre of the instructional process	49	23.3
	Reflect positive trends	47	22.7
	Develop pupils' process skills	44	21.1
	Help pupils in self learning	39	18.6
	Are excellent and developed methods to teach science	24	11.4
	Develop cooperation among pupils	24	11.4
	Give freedom to the pupils	19	9.0
	Allow pupils to participate effectively	17	8.1
	Are ideal methods	14	6.7
	Develop originality among pupils	7	3.3
	Help pupils to apply their prior experiences	4	1.9
	Are the most appropriate ways to teach science	3	1.4
Others	Need competent teachers	9	4.3
	Need time and effort	7	3.3
The ability to use these methods	Yes, I am able to use them	32	15.2
	I am able to use some of them	24	11.4
	I am able to use some of them but not effectively (to some extent)	94	44.8
	I am not able to use them (I do not think so)	41	19.5
Some methods they can use	Experiments	25	11.9
	Problem solving	14	6.7
	Guiding pupils to self learning	11	5.2
	Discovery learning	9	4.3
	Assignments	3	1.4
Possible reasons for inability to use these methods	There was not enough practice during the practicum to use these methods	57	27.1
	The educational courses did not focus enough on these methods	45	21.4
	The college staff have not trained us to use these methods	21	10
	The college staff use only lecturing	16	7.6
	These methods need a long time to be applied	16	7.6

n: number of responses for each item, %: percentage = number of responses for each item/ total of respondents

Table (5:3) indicates that student teachers generally had positive views towards experiential learning methods. Their opinions are grouped in 12 statements. The highest-rated responses were: "*they make pupils at the centre of the instructional process*" (n=49 /



23.3%); “*these methods reflect positive trends*” (n=47 / 22.7%) and “*they develop pupils’ process skills*” (n=44 / 21.1%).

Data gathered from interviews indicated that all student teachers and newly qualified teachers said that the trends of using experiential methods are extremely important and effective for the teaching and learning of science. For instance, a female teacher expressed her opinion on the importance of these methods and said:

*It is excellent that a pupil is in the centre of instructional learning. The experiential methods benefit pupils. This means that they apply their experiences, initiate, investigate, discover, create, and so on. In these methods, the pupils’ prior experience is an important basis for effective learning. Knowledge learned by these methods will continue and develop with the pupils. This knowledge cannot be forgotten (ST9).*

In this regard, a male teacher stated that:

*These trends are very important and they help pupils to be positive. They make them effective participants in the learning processes. These methods develop the scientific process skills and they are important for self learning (ST4).*

A student teacher reported his opinions of the new trends of the Ministry of Education in developing the teaching of science through experiential learning methods by saying:

*These are positive and developed steps. They will transform the education system in our country from its theoretical form to an excellent practical form, which fosters creativity and encourages the pupils’ scientific thinking (ST1).*

A female student teacher also said:

*Frankly, the reformed general education is a very developed educational system. In this system, education is based on the principle of pupil-centred learning. The teacher is regarded as a guide of instructional processes (ST11).*

Although student teachers had positive views towards the experiential learning methods, the majority of them could only use these methods to some extent (not effectively). As Table (5:3) indicates, 41 student teachers (19.5%) said that they were not able and 94



student teachers (44.8%) said they were able but not effectively (to some extent). However, only 32 student teachers (15.2%) said that they had the ability to use the experiential learning methods and 24 student teachers (11.4%) mentioned they were able to use some of them. In addition, interviewees also indicated that they were only able to use these methods to some extent (not effectively).

With regard to the student teachers' responses to "*some methods they can use effectively*", the highest-rated responses for "experiments" and "problem-solving method" were only 25 (11.9%) and 14 (6.5%) respectively, whereas the lowest-rated response for "assignments" was 3 (1.4%).

In addition, respondents mentioned the possible reasons for their lack of confidence in using these methods. These were:

- there was not enough practice during the practicum to use these methods (n=57 / 27.1%);
- the educational courses did not focus enough on these methods (n=45 / 21.4%);
- the college staff have not trained them to use these methods (n=21 / 10%);
- the college staff use only lecturing (n=16 / 7.6%) and
- these methods need a long time to be applied (n=16 / 7.6%).

It is clear that the key overall factor is a deficiency in the courses in the training colleges.

In the interviews, student teachers and teachers further confirmed that they have not effectively been trained to use these methods by the colleges. For instance, a female student teacher mentioned this by saying:

*Frankly, in the college, we have not studied the philosophy of the developed general education. We have been trained to work in the previous general education (ST12).*

When a male teacher was asked to respond to the following question: did the college prepare you to teach by using the experiential learning methods?, he answered : "no, we

had not been trained to use these methods” (NQT1). A student teacher made some suggestions as to how these methods could be applied:

*If the country wants these trends to be applied, a lot of things should be offered and appropriate attention should be given. Important issues such as: preparing effective teachers, changing the college’s curricula, proving the required facilities in the colleges and providing the needed facilities in the schools should be taken care of in order for these new trends to function successfully (ST2).*

In the questionnaire, 19 educators responded to the item of “student teachers abilities to teach by using the experiential learning methods”, (Table 5:4).

**Table 5-4 Educators’ views on the student teachers’ abilities to use experiential learning methods**

Categories	Subcategories	n	%
The ability to use these methods in teaching	Yes, they have the ability to use them	3	15.8
	They are able to use some of them	3	15.8
	They are able to use some of them but not effectively (to some extent)	8	42.1
	They are not able to use them (I do not think so)	5	26.3
Some methods they can use	Experiments	8	42.1
	Problem solving	5	26.3
	Discovery learning	3	15.8
	Co-operative learning	1	5.3
Possible reasons for inability to use these methods	There was no enough practice during the practicum to use these methods	7	36.8
	The educational courses did not focus enough on these methods	6	31.6
	Student teachers have not been taught through these methods, i.e., the educators use only the lectures in their teaching	1	5.3

n: number of responses for each item, %: percentage = number of responses for each item/ total of respondents

5 educators (26.3%) mentioned that student teachers were not able to use these methods and 8 educators (42.1%) said they could use them but not effectively (to some extent). However, only 3 educators (15.8%) said that student teachers had the ability to use the experiential learning methods and 3 educators (15.8%) indicated that student teachers were able to use some of them.

In the interviews, some educators (n=5) said that student teachers could use these methods to some extent but not effectively. One educator mentioned that “*teachers graduated from the colleges of education could use the experiential learning methods if the necessary facilities were provided*” (E8C). One of them reported that:



*I could not say that all the student teachers could use these methods. Only a few of them could use them and only to some extent. It depends on the competence of the student teachers (E1C).*

One educator reported that:

*I believe that the college's educational courses and practicum have not contributed effectively in preparing student teachers to use experiential learning methods in their teaching (E2C).*

The highest-rated response of the educators in the questionnaires to the “some methods that student teachers could use effectively” was 8 (42.1%) for “experiments” whereas the lowest-rated response was for “Co-operative learning” and it was only 1 (5.3%). Reasons for the inability to use these methods mentioned by educators were:

- there was not enough practice during the practicum to use these methods (n=7/ 36.8%);
- the educational courses did not focus enough on these methods (n=6 / 31.6%);
- student teachers have not been taught through these methods, i.e., the educators use only lectures in their teaching” (n=1 / 5.3%).

One of the educators in an interview highlighted reasons for the insufficient training in the college. These were:

- *The Science Teaching Methods Course had a lot of theoretical aspects and there was no time available for practical parts,*
- *The references and resources in the colleges were out-of date and did not help train student teachers to use these methods,*
- *Tutors had to follow the courses' descriptions, which did not help to train student teachers to apply these methods (E3C).*

In the educators' interviews, all of them attributed the insufficient training to the limited resources. As a female educator said that:

*The learning principle in Oman is pupil-central learning and experiential learning methods. However, limited resources cause the lack of training of student teachers to teach by using these methods (E8C).*



## 5:2:2 Student Teachers' competencies in Assessment and Evaluation

The questionnaire elicited 11 items from the student teachers and educators about their views on student teachers' abilities to use assessment and evaluation skills. Table 5:5 presents the descriptive statistics of these 11 items. This includes: mean ratings of Likert scale responses and ranking.

**Table 5-5 Student teachers' Competencies in assessment and evaluation as viewed by student teachers and educators**

Assessment and evaluation competencies	Student teachers	Educators	Mean	Rank
Set tasks that are closely linked to the learning outcomes and objectives	3.47	3.31	3.39	2
Measure higher cognitive skills in science (evaluation, synthesis, analysis)	2.82	3.33	3.08	6
Consider each pupil's individual learning style in the assessment	3.49	3.16	3.33	3
Use a variety of assessment methods (observation, interviews, reports, self-assessment, achievement tests)	3.24	3.02	3.13	5
Assess the understanding of the problem-solving process	2.72	3.24	2.98	9
Guide pupils to use self-assessment sheets which allow them to become involved in their own assessment	2.61	2.96	2.79	11
Use a computer to record the pupils' examination results	3.16	2.98	3.07	7
Analyse pupils' examination results	3.03	2.80	2.92	10
Write clear reports of pupils' achievements or progress	3.41	3.20	3.31	4
Use the assessment results in evaluating teaching methods and course contents	3.09	2.94	3.02	8
Provide appropriate feedback to pupils	3.43	3.37	3.40	1
<b>The overall means</b>	<b>3.13</b>	<b>3.11</b>	<b>3.12</b>	

5-point scale: 1= the lowest, 5= the highest. Student teachers (n) = 271, Educators (n) = 47

The overall mean rating of all the student teachers' assessment and evaluation competencies was 3.12. The highest mean rating for these skills for "provide appropriate feedback to pupils" was 3.40 whereas the lowest mean rating for "guide pupils to use self-assessment sheets which allow them to become involved in their own assessment" was 2.79. For all the items, the mean ratings did not approach 3.5; i.e. all of these competencies fell in "average" category.

Qualitative data generated from an open-ended question in the questionnaire about the student teachers skills and their ability to use different assessment tools provides a useful

basis for interpreting quantitative data. 209 student teachers (77%) responded to this item (Table 5:6).

**Table 5-6 Student teachers' opinions on new trends of assessment and evaluation and their abilities to use them**

Categories	Subcategories	n	%
Student teachers' opinions, these methods:	Present the real level of pupils	57	27.3
	Consider pupils' individual differences	48	23.0
	Give clearer results	41	19.6
	Assess different levels of pupils	37	17.7
	Give effective feedback	26	12.4
	Help to identify the pupils' weaknesses	21	10.0
The ability to use these methods	Yes, I am able to use them	26	12.4
	I am able to use some of them	41	19.6
	I am able to use some of them but not effectively (to some extent)	78	37.3
	I am not able to use them (I do not think so)	34	16.3
Some methods they can use	Tests	187	89.5
	Observation	12	5.7
	Assignments	9	4.3
	Interviews	5	2.4
	Reports	4	1.9
The reasons for inability to use these methods	There was not enough practice during the practicum to use these methods	46	22.0
	The educational courses did not focus enough on these methods	41	19.6
	College staff just used tests in their assessment and did not use other assessment methods	32	15.31

n: number of responses for each item, %: percentage = number of responses for each item/ total of respondents

All the student teachers' responses about the new trends of the Ministry of Education in using different methods to assess pupils in science were positive. The highest-rated item was "*these methods present the real level of pupils*" (n=57 / 27.3%). This item was followed by "*these methods consider pupils' individual differences*" (n=48 / 23%). The lowest-rated item was "*these methods help to identify the pupils' weaknesses*" (n=21 / 10%).

In the interviews, all student teachers and newly qualified teachers also mentioned that a variety of assessment methods should be used to assess different levels of pupils and to get better outcomes of learning and teaching.



However, in the questionnaire, the responses indicated that student teachers have not been effectively trained to apply different methods of assessment. Only 26 student teachers (12.4%) said that they were able to use these methods and 41 student teachers (19.6%) indicated that they were able to use some of them. On the other hand, 78 respondents (37.3%) mentioned that they were able to use them, but not effectively (to some extent) and 34 respondents (16.3%) said they were not able to use them at all.

With regard to student teachers' responses to the tools that they could use effectively, the majority of responses (187/ 89.5%) indicated that they could use *tests*. The greatest percentage for using other assessment methods was only 5.7% (n=12) for "*observation*" whereas the lowest percentage was 1.9% (n=4) for "*reports*". In interviews, the newly qualified teachers and student teachers mentioned that they could use exams, reports and assignments in the assessment of pupils but not effectively.

In addition, student teachers pointed out the reasons for the inability to use these methods.

The highest-rated reasons were:

- there was not enough practice during the practicum to use these methods(n=46 / 22%);
- the educational courses did not focus enough on these methods(n=41 / 19.6%);

Furthermore, some student teachers blamed educators for the insufficient training in the colleges. They mentioned that "*College staff just used tests in their assessment and did not use other assessment methods*" (n=32 / 15.31%).

In the interviews, interviewees reported some reasons for their inability to use different methods of assessment, e.g. the training was theoretical and focused on exams. A female student teacher said: "*we studied some assessment methods theoretically. We took their strengths and weaknesses. But we did not apply these methods. We applied only exams*" (ST8).



36 educators responded to the open-ended question about the student teachers' abilities to use different assessment tools (Table 5:7).

**Table 5-7 Educators' views on student teachers abilities to use different assessment tools**

Categories	Subcategories	n	%
The ability to use these methods	Yes, they are able to use them	5	13.9
	Yes, they are able to use some of them	7	19.4
	They are able to use some of them but not effectively (to some extent)	14	38.9
	They are not able to use them (I do not think so)	7	19.4
Some methods they can use	Tests	35	100
	Assignments	5	14.3
	Reports	2	5.7
The reasons for inability to use these methods	The educational courses and practicum did not address the required assessment tools of the reformed system	21	58.3
	The training focused to use exams	14	38.9
	The assessment methods in the college are still traditional (using exams)	5	13.9

n: number of responses for each item, %: percentage = number of responses for each item/ total of respondents

Only 5 educators (13.9%) indicated that student teachers were able to use these assessment methods and 7 respondents (19.4%) indicated that they could use some of them. On the other hand, 7 respondents (19.4%) mentioned that student teachers were not able to use them and 14 respondents (38.9%) said that they could use these methods but not effectively (to some extent).

In addition, 2 responses (5.7%) and 5 responses (14.3) indicated that student teachers could use reports and assignments respectively whereas 35 responses (100%) indicated that they could use tests. Furthermore, in the interviews, educators said that student teachers have not been trained enough to use different assessment methods. An educator expressed this by saying:

*Yes, student teachers have been trained to use different assessment methods but not effectively. As you know the assessment methods in the reformed general education do not focus on the quantity measurement, i.e. measuring what pupils memorise by using traditional exams but on measuring higher cognitive levels, practical skills, attitudes, and so on by using different assessment methods. Student teachers have not been effectively trained to use these methods. So, even with exams, student teachers are not able to*

*measure the higher cognitive skills rather than use the other assessment methods skills (E1C).*

In the questionnaires, the educators mentioned three major reasons for the inability of student teachers to use the required assessment methods. These were: “*the educational courses and practicum did not address the required assessment tools of the reformed system*” (n=21/ 58.3%), “*the training focused on use of exams*” (n=14/38.9%) and “*the assessment methods in the college are still traditional (using exams)*” (n=5/ 13.9).

### 5:2:3 Student Teachers' Competencies in the Problem-Solving Approach

The questionnaire elicited 15 items from the student teachers and educators about their views on student teachers' competencies in designing and implementing a problem-centred approach to teaching. Table 5:8 shows the descriptive statistics of these 15 items. This includes: mean ratings of Likert scale responses and ranking.

**Table 5-8 Student teachers' competencies in designing and implementing a problem-centred approach as viewed by student teachers and educators**

<b>Problem solving competencies</b>	<b>Student teachers</b>	<b>Educators</b>	<b>Mean</b>	<b>Rank</b>
Present problems that are based on the pupils' interests	2.64	2.77	2.71	14
Present problems in a meaningful and relevant context	2.61	2.98	2.80	11
Incorporate thinking skills into the lessons	2.60	2.93	2.77	13
Provide open-ended tasks	2.89	3.06	2.98	5
Identify pupils' prior knowledge needed to solve the problems	2.80	2.89	2.85	8.5
Provide hands-on activities	3.14	3.19	3.17	2
Design lessons that incorporate pupils' planning as part of their problem-solving	2.65	2.91	2.78	12
Provide pupils with a variety of printed and non-printed resources	2.78	2.91	2.85	8.5
Encourage pupils to research and use materials other than those provided by student teachers	2.69	3.02	2.86	7
Extend pupils' learning by posing open-ended questions	2.40	3.00	2.70	15
Ask questions in a variety of ways	2.68	3.17	2.93	6
Probe pupils' answers	3.30	3.09	3.20	1
Focus on developing the pupils' reasoning skills, rather than the correctness of the answers	2.64	3.04	2.84	10
Modify science lessons to suit the interest of the pupils	2.83	3.21	3.02	4
Raise pupils' self-esteem	2.87	3.23	3.05	3
<b>The overall means</b>	<b>2.77</b>	<b>3.02</b>	<b>2.9</b>	

5-point scale: 1= the lowest, 5= the highest. Student teachers (n) = 271, Educators (n) = 47

The overall mean rating of the student teachers' competencies in using the problem-solving approach is 2.9. The highest mean rating for "*probe pupils' answers*" was 3.20 whereas the lowest mean rating was 2.70 for "*extend pupils' learning by posing open-ended questions*". For all the items, the mean ratings fell in the "*average*" category and did not approach 3.5.



In the student teachers' questionnaire, 191 student teachers out of 271 (70.5%) answered the following question: "What are the strengths and weaknesses of the problem-solving methods"? (Table 5:9).

**Table 5-9 The strengths and weaknesses of the problem-solving methods as reported by student teachers**

Categories	Subcategories	N	%
The strengths	Developing scientific thinking skills (process skills)	43	22.5
	Applying pupil centred learning	42	22.0
	Pupils participate in a real and active learning environment	35	18.3
	Helping pupils to understand	32	16.8
	Making science lessons more interesting	28	14.7
	Considering pupils' individual differences	27	14.1
	Developing both cognitive and affective outcomes	26	13.6
	Helping pupils' self-learning	24	12.6
	Developing positive pupils' attitudes towards learning	22	11.5
	Encouraging pupils' thinking in a competitive way	21	11.0
	Increasing pupils' motivation towards learning	21	11.0
	Developing the cooperation between pupils	18	9.4
	Developing pupils' dependence	17	8.9
	Strengthening the relationship between pupils themselves and between pupils and teacher	15	7.9
	Relating lesson to environment	14	7.3
	Developing pupils' confidence	13	6.8
	Applying the results of solved problems in solving other problems	12	6.3
	Discovering the pupils' weaknesses in learning	9	4.7
The weaknesses	Its application needs long time	51	26.7
	Preparing for this method needs a big effort from the teacher	32	16.8
	It needs a lot of resources	19	9.9
	If pupils did not solve the problem, they might become frustrated	13	6.8
	Some administrative problems might occur	10	5.2
	Some pupils depend on others in solving a problem	9	4.7
	It needs continuous follow up	7	3.7
	It needs very skilled and well-prepared teachers	11	5.8
Others	The college tutors do not believe in the new science teaching methods	5	2.6
	The tutors themselves need to be trained to use these method	3	1.6
	We have not practised this method in our teaching	2	1.0
	It has no weaknesses	2	1.0

n: number of responses for each item, %: percentage = number of responses for each item/ total of respondents

Student teachers' responses indicated that they had positive views towards the problem-solving approach. Its strengths significantly outweighed its weaknesses as the respondents mentioned. Strengths mentioned by student teachers are placed in 18 categories. The three highest-rated strengths were: "developing scientific thinking skills (process skills)" (n=43 / 22.5%); applying "pupil centred learning" (n=42 / 22%) and "pupils participate in a real and active learning environment" (n=35 / 18.3%).

Few weaknesses were mentioned by student teachers compared to the strengths. Weaknesses mentioned were placed in 7 categories. The three highest-rated categories were: *“its application needs a long time”* (n=51/ 26.7%); *“preparing for this method needs a big effort from the teacher”* (n=32/ 16.8%) and *“it needs a lot of resources”* (n=19 / 9.9%).

In addition, other respondents (11/ 5.8%) mentioned that *“this approach needs very skilled and well-prepared teachers”*. 2 student teachers (1.0%) said: *“this approach has no weaknesses”*. 2 of them said: *“we have not practised this method in our teaching.*

Furthermore, some student teachers blamed educators for the limited training that they received. They said that the *“the college tutors do not believe in the new science teaching methods”* (n=5 / 2.6%) and *“The tutors themselves need to be trained to use these methods”* (n=3 / 1.6%).

In the interviews, student teachers and teachers said that they were taught the problem solving method theoretically. They can state its steps. A male teacher said that:

*We know the steps of this method and we took one example. It was just theoretical and we did not apply it during the practicum (NQT2).*

Many interviewees mentioned that supervisors did not encourage them to use this method through their training. A male teacher said, *“supervisors did not encourage us to use this method during the practicum”* (NQT2). A female student teacher identified other reasons for inefficiency in training by saying:

*Education courses and workshops did not address the practice of this method; there was no time to apply it, and the required facilities were not available (ST12).*



In an interview, a female student teacher reported that “*the content of problem solving in the “Science Teaching Methods Course” was too little*” (ST11). Document examination of the description of this course indicated that this course has 60 contact hours. “*The aspect of problem solving approach*” was included in the unit of science teaching approaches. This aspect was taught in one contact hour. Thus, this aspect represented only about 1.67% from the whole course.

In the educators’ questionnaire, they were asked to answer the following question: “Are student teachers able to teach effectively using problem-solving methods? If not, why?” 18 educators answered this question (Table 5:10).

**Table 5-10 Educators’ views on student teachers’ abilities to use the problem-solving approach**

Categories	Subcategories	n	%
Are they able?	Yes, they have the abilities	2	11.1
	They are able to some extent	7	38.9
	They are not able (I do not think so)	9	50.0
The reasons for inability to use these methods	They have not been trained enough to use this method	12	66.7
	This method was taught theoretically	8	44.4
	They have been trained to use traditional methods	3	16.7
	It needs a big effort	3	16.7
	Educators themselves do not know how to use this approach	1	5.6

n: number of responses for each item, %: percentage = number of responses for each item/ total of respondents

9 educators (50%) indicated that student teachers were not able to use problem-solving methods in their teaching and 7 of them (38.9%) also reported that they were able to some extent. Only 2 respondents (11.1%) said that student teachers could use this method. Educators mentioned five reasons for student teachers’ inability to use these methods.

These were:

- they have not been trained enough to use this method (n=12/ 66.7%);
- this method was taught theoretically (n=8/ 44.4%);
- they have been trained to use traditional methods (n=3/ 16.7%);
- it needs a big effort (n=3/16.7%);
- educators themselves do not know how to use this approach (n=1/ 5.56%).



Some educators, however, mentioned in the interviews that a few student teachers could use the problem-solving method in the teaching of science. An educator stated that “*I believe that a very small percentage of student teachers could use this approach in the teaching of science*” (E7C). Another educator said: “*from my point of view, student teachers have not been trained enough to use the problem-solving approach*” (E10C). He continued mentioning some reasons for this by saying:

*The problem-solving method needs special strategies to be applied. Education courses, especially curriculum and teaching methodologies’ courses, did not address it in an effective way* (E10C).

Another educator added:

*Student teachers applied traditional teaching methods during college-based and school-based practicum. These methods depend entirely on a teacher-centred approach not on a pupil-centred approach. Student teachers, unfortunately, have been evaluated on their abilities to memorise and repeat the scientific content* (E3C).

Another educator mentioned other reasons for student teachers’ inability to use this method. Those were: “*the lack of resources (microteaching labs, scientific labs, other facilities), the nature of college courses, lack of encouragement, lack of time, and so on*” (E4C).

In short, the results indicate that the student teachers have not been trained effectively to use the required teaching and assessment methods recommended by the Ministry of Education. In addition, some educators (n=4) reported the importance of in-service training programmes. They mentioned that these programmes should be organised for teachers. An educator said, “*in-service training programmes are very important. These are to remedy the lack of training in pre-service training programmes*” (E19A).

## 5:3 Pedagogical Courses

The results of the importance and effectiveness of the pedagogical courses, as viewed by student teachers, educators and newly qualified teachers, are reported in two main sections. These two sections present the quantitative and qualitative results obtained through student teachers and educators' questionnaires. This was supported by qualitative findings from interviews of student teachers, educators and newly qualified teachers.

### 5:3:1 The Importance and Effectiveness of the Pedagogical Courses as Viewed by Student Teachers

The questionnaire elicited 11 items from the student teachers about their views on the importance and effectiveness of the pedagogical courses. Table 5:11 presents descriptive statistics of each of the 11 items for both scales (*importance* and *effectiveness*): mean ratings of Likert scale responses.

**Table 5-11 The importance and effectiveness of pedagogical courses as viewed by student teachers**

Pedagogical courses	Importance (mean)	Effectiveness (mean)
Education foundation	3.29	1.71
Research foundation & statistics	4.23	2.83
Educational psychology	3.74	2.26
Educational evaluation & psychological assessment	4.13	2.76
Curriculum	3.58	2.37
Educational technology	4.56	2.62
School management	3.97	2.32
Comparative educational systems	3.43	2.21
Development psychology and psychological health	4.18	2.78
Science teaching methods	4.77	3.48
Elective course in education	3.20	1.87

5-point scale: 1= the lowest, 5= the highest. Student teachers (n)=271

Table 5:11 displays the mean ratings for the importance of pedagogical courses, which ranged from 3.20 for "*Elective course in education*" to 4.77 for "*Science Teaching Methods Course*". All courses were rated "*important*" except "*Elective course in education*" and "*Education foundation*" which were rated "*average*". The highest-rated courses were:



- Science Teaching Methods (4.77);
- Educational Technology (4.56);
- Research Foundation and Statistics (4.23);
- Development Psychology and Psychological Health (4.18).

The mean ratings of the effectiveness of all the pedagogical courses were rated “average” i.e. “not effective”. The highest rated course was “*Science Teaching Methods Course*”. The lowest-rated courses were:

- Education foundation (1.71);
- Elective course in education (1.87);
- Comparative educational systems (2.21).

### 5:3:1:1 Strengths of the Pedagogical Courses as Reported by Student Teachers

98 student teachers (36%) responded to the questions of “*the most important strengths in the pedagogical courses*” (Table 5:12).

**Table 5-12 Strengths in the pedagogical courses as addressed by student teachers**

Categories	Subcategories	n	%
Curriculum and methodology courses	Teaching methods	31	31.6
	Assessment methods	23	23.5
	Knowing teaching skills	21	21.4
	Studying the goal, aims and objectives of science	9	9.2
	The elements of the curriculum	8	8.2
	The importance of technology in teaching and learning	6	6.1
	The methods of curriculum analysis and development	4	4.1
Psychology courses	Supplying student teachers with the physical, psychological and mental characteristics and concepts of the pupils' growth phases	32	32.7
	Learning theories	16	16.3
	Recognising the kinds of tests	6	6.1
Education foundation and administration courses	The basic concepts of school administration	15	15.3
	The administration role of teacher	8	8.2
	Understanding and analysing the Omani education system and comparing it with other education systems	5	5.1
	Basic concepts of education	4	4.1
	The elements of the education system	4	4.1
Other	There were not strong points	1	1.0

n: number of responses for each item, %: percentage = number of responses for each item/ total of respondents

Student teachers' responses indicated that the most important strengths in the three categories of pedagogical courses were:

- teaching methods (n=31/ 31.6%) for Curriculum and Methodology Courses;



- supplying student teachers with the physical, psychological and mental characteristics and concepts of the pupils' growth phases (n=32/ 32.7%) for Psychology courses;
- the basic concepts of school administration (n=15/ 15.3%) for Education foundation and administration courses respectively.

Analysis of student teachers' and teachers' interviews' results indicated that **all** the courses were important for preparing prospective teachers. A female student teacher said that "*all educational courses were important though they varied in the degree of importance*" (ST7). Another student teacher reported that "*some of the educational courses were very beneficial, especially those directly linked to the field of teaching*" (ST3).

They mentioned that these courses provided them with the basic knowledge related to the curriculum, teaching methods, assessment and evaluation methods, school management and psychology. For example, a female teacher said that:

*Curriculum and teaching methods courses provided us with the knowledge of curriculum organisation and analysis, and instructional technology. They also provided us with the methods and strategies of planning, delivering and evaluating lessons. Frankly, studying these courses benefited us greatly.* (NQT4).

Another female teacher said that:

*Psychology courses benefited us by helping us to consider the pupils' differences during the planning and applying teaching and assessment methods* (NQT5).

### **5:3:1:2 Weaknesses of the Pedagogical Courses as Reported by Student Teachers**

172 student teachers (63.5%) gave their views on "*the most important weaknesses in the pedagogical courses*" (Table 5:13).

**Table 5-13 Weaknesses in the pedagogical courses as reported by student teachers**

Categories	Subcategories	n	%
All courses	Huge theoretical content and the time for practical part was limited	68	39.5
	Repetition	42	24.4
	References for these courses were irrelevant and insufficient	34	19.8
	Required resources were not enough	32	18.6
	Not linked to developed general education in the schools	28	16.3
	Assessment depended entirely on exams	27	15.7
	Teaching methods focused mainly on lecturing	21	12.2
	Staff did not give enough attention to these courses	18	10.5
	Staff were not competent	9	5.2
	Did not study problems that were in schools	7	4.1
	Were boring	6	3.5
	No integration of these courses and subject-matter courses	5	2.9
	Not related to the teaching of science	4	2.3
	Some contents were out of date	4	2.3
	Not beneficial	3	1.7
Opinions of student teachers on how to develop these course were not considered	2	1.2	

n: number of responses for each item, %: percentage = number of responses for each item/ total of respondents

The most important weaknesses mentioned by student teachers were:

- huge theoretical content and the time for practical part was limited (n=68 / 39.5%);
- repetition of these courses (n=42 / 24.4%);
- references for these course were irrelevant and insufficient (n=34 /19.8%).
- required resources were not enough (n=32 / 18.6);
- they were not linked to developed general education in the schools (n=28/ 16.3%);
- assessment depended entirely on exams (n=27 /15.7%);
- teaching methods focused mainly on lecturing (n=21 /12.2%);

The analysis of student teachers and teachers' interviews' results indicated that these courses had a lot of weaknesses. For instance, a female teacher mentioned that "*the weaknesses of educational courses were much more than their strengths*" (NQT3). The most frequent weaknesses mentioned in the interviews were:

- repetition of some aspects (n=17);
- huge theoretical content and limited time for practical experience (n=14) e.g. Science Teaching Methods Course and Development Psychology Course;
- some aspects were irrelevant (n=6); and some aspects were omitted (n=3);
- criticising educators' role in teaching and assessment of these courses (n=15);
- insufficient resources (n=15).

In terms of the repetition, some interviewees mentioned examples such as "*statistics*", which was taught in two courses: Educational Evaluation and Psychological Assessment,



and Research Foundation and Statistics. Another example mentioned by student teachers was “*education aims*”, which were repeated in the Education Foundation Course, Science Teaching Methods Course, and in many practicum workshops. Table (5: 14) presents some examples of the repetition of some aspects based on the reviewing of the curriculum syllabi.

**Table 5-14 Examples of the repetition of some aspects of educational courses**

Aspects	Courses' name	Contact hours of aspects	%
Statistics	Educational evaluation & psychological assessment (60 contact hours)	12	20
	Research foundation and statistics course (60 contact hours)	16	26.7
Education aims	Education foundation (45 contact hours)	6	13.3
	Science Teaching Methods (60 contact hours)	1	3.3
	Planning competency workshops (14 contact hours), semester three	1	7.1
	Planning competency workshops (14 contact hours), semester six	1	7.1

%:Percentage of credit hours (contact hours of each aspect/ the total of contact hours of the course)

In addition, this repetition generated a huge theoretical content. A male student teacher said: “*there was not enough practical work in the college because of the huge theoretical content*” (ST5) and another student teacher questioned “*what were the benefits from studying these courses, if we could not practice them?*” (ST6). Some interviewees added another point to the weaknesses of applying educational courses: the time provided to teach these courses was not enough. This was due to the huge theoretical content of these courses, consuming a lot of time in the school-based practicum, and holidays.

Interviewees reported that the content of some courses was irrelevant to the teaching of science. Some aspects were out of date. For example, one of the male student teachers said that:

*Comparative Educational Systems” was supposed to be a good course but it was not well organised. We took the old Japanese education system, which was really a bad thing* (ST1).



In addition, his colleague questioned “*Why were not we taught the new educational system in Japan, England, France, or the USA*” (ST2). One of the student teachers added that, “*in the unit on the Oman’s education system*”, *we were taught the previous education system not the newly reformed general education*” (ST3). One of the student teachers said “*the aspects of this course were good if they were delivered in a proper way*” (ST2). Examination of the content of this course indicated that it had five aspects. These aspects are presented in table (5: 15).

**Table 5-15 Aspects of the Comparative Educational Systems Course**

<b>Units of course</b>	<b>Contact hours</b>
The meaning and nature of comparative education	12
Characteristics of education systems in developed countries (an example)	9
Characteristics of education systems in developing countries (an example)	6
Characteristics of education systems in Gulf Cooperation Countries (an example)	6
Oman’s education system	12
<b>Total</b>	<b>45</b>

However, in practice, the implementation of this course was incorrect, according to student teachers. They indicated that they studied the old educational system of Japan and the previous educational system of Oman. The benefits of this course could be improved if student teachers were taught contemporary education systems in Japan or any educational system of any developed country such as England, the USA, or any other country. In addition, it is more beneficial for student teachers if they were taught the reformed general education in Oman instead of studying the previous education system.

Some student teachers indicated that in the School Management Course, there were no aspects about classroom management, as one of them said:

*There was a huge content about school management and there was not content about classroom management, which is very important for a teacher to know* (ST4).

Examination of the aspects of this course indicated that all aspects were related to school management and there was not content at all about classroom management. A student

teacher said, *“we are going to be teachers not administrators. So we need to study some thing about classroom management”* (ST5).

In the interviews, the majority of student teachers and teachers criticised the role of tutors in delivering these courses. For example, a female student teacher said that:

*When some educators taught us, they were just reading from a book, we were writing what they were saying and we had to memorise this for the exams. This happened not only in educational courses but also in subject matter courses* (ST7).

Her colleague said:

*I believe that there was a big gap between what the descriptions of the college courses say and the way we had been taught. Although, all the courses’ descriptions recommend varying teaching methods in applying these courses, we had been taught by lecturing. This of course was reflected negatively on our teaching in the schools* (ST9).

Another male student teacher said, *“there was some pressure caused by the three exams for each course”* (ST4). His colleague added:

*To pass these courses, we had to memorise the massive theoretical content and after the exams we forgot all about it* (ST5).

A female teacher also mentioned that:

*Although there was an assignment beside the exams in some courses, the tutor did not review this assignment with student teachers. Student teachers were not allowed to see and discuss their assignments again to know what the strengths and weaknesses were* (ST10).

Some interviewees insisted that the weaknesses were in the tutors not in the nature of these courses. When female student teachers were asked, *“is there any weakness in the nature of these courses”*? They answered *“no”* (ST10, ST11, ST12). One of them continued saying, *“the weaknesses were in the tutors, who were supposed to be responsible and able to reorganise, select, and deliver what were beneficial aspects for us but they were not”* (ST10). In addition, one of these interviewees said:



*We heard that our colleagues benefited a lot from the tutor who taught the School Management Course and we did not benefit from this course, although, we studied it in the same semester and the syllabus description of the course was the same. So, the weakness was in the tutor not in the course' description (ST12).*

Furthermore, a student teacher continued to blame some college tutors by saying “*let us speak frankly, some of the teaching staff were not sincere in their work. They were not wholehearted*” (ST11).

This result was supported by many interviewees. For examples, there were different answers responding to the questions about the most important weaknesses and the most important strengths of the educational courses. Some of the interviewees, for example, said that the School Management Course was very beneficial and some of them said that this course was not beneficial. Some said that the Educational Psychology Course and Development Psychology Course were very beneficial and others said these courses were not so beneficial.

Interviewees also reported that there were insufficient resources in the colleges. For example, there was not enough equipment in the laboratories and some references were out-of date and limited. A female teacher said, “*the facilities and equipment in the schools were better than in the colleges*” (NQT3). A female teacher criticised the college library by saying:

*The college library contained a lot of out-of-date references. These references were also not enough, and irrelevant to the educational field. In addition, they were not organised in a systematic way. For example, if you wanted a book you could not find it easily, you have to search through all the references (NQT3).*

With regard to the equipment of the science laboratories, one of the female teachers said:

*The college's science labs were not well equipped. We were really surprised; schools' labs were better equipped than college's labs. We studied some*



*courses in the college without any practical work because of the shortage of the facilities (NQT4).*

### 5:3:1:3 How Can the Pedagogical Courses be Developed?

152 (56%) student teachers responded to the following question: *“How the effectiveness of these courses can be improved to meet the requirements of the reformed general education of the Ministry of Education? (Table 5: 16).*

**Table 5-16 Student teachers’ suggestions to improve the pedagogical courses**

Categories	Subcategories	n	%
The content of the courses and learning environment	Minimising the theoretical content and providing enough time for practical part	35	23
	Redesigning these courses to be related to and accordant with the requirements and school curricula of the Ministry of Education	31	20.4
	Varying the teaching and assessment methods in teaching the content of these courses	29	19.1
	Avoiding the repetition of these courses	21	13.8
	Combining some of these courses together	13	8.6
	Studying new trends in the pedagogy	11	7.2
	Replacing the repeated aspects of these courses with subject-matter courses	11	7.2
	Integrating theory and practical parts	6	3.9
	Integrating science subject-matter courses and education courses	5	3.3
	Relating these courses with in-service professional development	4	2.6
Staff	Selecting competent staff to teach these courses	6	3.9
	The college should follow up the staff	11	7.2
Resources	Providing new and enough references that are related to the requirements of the reformed general education	33	21.7
	Providing the required resources	12	7.9
Curriculum and methodology courses	Paying more attention to the science teaching methods course	13	8.6
	Paying more attention to the educational technology course	11	7.2

n: number of responses for each item, %: percentage = number of responses for each item/ total of respondents

The highest-rated responses from student teachers on how to improve the content of the educational courses and learning environment were:

- minimising the theoretical content and providing enough time for the practical work part (n=35/ 23%),
- Providing new and enough references that are related to the requirements of the reformed general education (n=33/ 21.7%),
- redesigning these courses to be related to and accordant with the requirements and school curricula of the Ministry of Education (n=31/ 20.4%),
- varying the teaching and assessment methods in teaching the content of these courses (n=29/19.1),
- avoiding the repetition of these courses (n=21/ 13.8%),

In addition, the student teachers mentioned two other items that might improve the curriculum and methodology courses. These were: “*paying more attention to the Science Teaching Methods Course*” (n=13/ 8.6) and “*paying more attention to the educational technology course*” (n=11/ 7.2%).

In the interviews, student teachers and teachers reported the importance of overcoming the weaknesses of the pedagogical courses. For example, all the interviewees mentioned that it is important to reduce the theoretical content of these courses. This might be done by deleting the repeated and irrelevant aspects of these courses. Many interviewees suggested replacing the repeated aspects of these courses with subject-matter courses. In addition, the interviewees stated the importance of providing all the necessary resources.

In addition, many of them (n=8) reported that, in order to develop educational courses, it is necessary to link schools’ needs with college programmes. For example, a male teacher stated that:

*If we need to develop these courses, it is necessary to look at the reality in schools. We have to study the schools, what they need, what they focus on, what their curricula are...then, we design the colleges’ curricula (NQT2).*



### 5:3:2 The Importance and Effectiveness of the Pedagogical Courses as Viewed by Educators

The questionnaire elicited 11 items from the educators about their views on the importance and effectiveness of the pedagogical courses (Table 5:17). This table presents descriptive statistics of each of the 11 courses for both scales (*importance* and *effectiveness*): mean ratings of Likert scale responses.

**Table 5-17 The importance and effectiveness of pedagogical courses as viewed by educators**

Pedagogical courses	Importance (means)	Effectiveness (means)
Education foundation	3.82	3.15
Research foundation & statistics	4.26	3.03
Educational psychology	4.24	2.93
Educational evaluation & psychological assessment	4.34	3.10
Curriculum	4.22	3.31
Educational technology	4.49	3.41
School management	3.88	3.08
Comparative educational systems	3.50	2.96
Development psychology and psychological health	4.14	3.22
Science teaching methods	4.78	3.79
Elective course in education	3.25	2.43

5-point scale: 1= the lowest, 5= the highest. Educators (n)=105

Table 5:17 presents the mean ratings for the importance of pedagogical courses, which ranged from 3.25 for “*Elective course in education*” to 4.78 for “*Science teaching methods course*”. The majority of courses were rated “*important*”. The greatest-rated courses were:

- Science teaching methods (4.78);
- Educational technology (4.49);
- Educational evaluation & psychological assessment (4.34).

The mean ratings for the effectiveness of these pedagogical courses ranged between 2.43 and 3.79. All mean ratings for the effectiveness were viewed “*average*” except for “*Science teaching methods course*” which was rated “*effective*”. The lowest-rated courses were:

- Elective course in education (2.43),
- Educational psychology (2.93),
- Comparative educational systems (2.96).



### 5:3:2:1 Strengths of the Pedagogical Courses as Reported by Educators

With regard to the educators' views of "*the most important strengths in the pedagogical courses*", table 5:18 presents their responses.

**Table 5-18 Strengths in the pedagogical courses as viewed by educators**

Categories	Subcategories	n	%
Curriculum and methodology courses (n=31)	Identifying the elements of curriculum	5	16.1
	Recognising the nature of science	2	6.5
	Studying the goal, aims and objectives of science	6	19.4
	Knowing the methods of curriculum analysis and development	1	3.2
	Identifying the teaching and assessment methods	19	61.3
	Acquiring the knowledge of planning, teaching and assessment	21	67.7
	Knowing the importance of technology in teaching and learning and knowing the basic concepts of the education technology	5	16.1
	Training student teachers to use instructional kits	3	9.7
	Producing some instructional materials	2	6.5
Psychology courses (n=19)	Supplying student teachers with the physical, psychological and mental characteristics and concepts of the pupils' growth phases	14	73.7
	Recognising the kinds of tests	4	21.1
	Knowing learning theories	11	57.9
	Knowing research concepts	5	26.3
	Knowing statistic concepts	3	15.8
Education foundation and administration courses (n=16)	Knowing basic concepts of education	4	25
	Knowing the philosophy of education	1	6.2
	Knowing the basic concepts of school administration	8	50
	Knowing the administration role of the teacher	7	43.8
	Knowing the elements of the educational system	4	25
	Understanding and analysing the Omani educational system and comparing it with other educational systems	3	18.8
	Analysing some current educational issues	2	12.5

n: number of responses for each item, %: percentage = number of responses for each item/ total of respondents

In the questionnaire, the strengths of the education courses most commonly mentioned by educators were:

- "acquiring the knowledge of planning, teaching and assessment" which was mentioned by 21 educators (67.7%) for Curriculum and methodology courses;
- "supplying student teachers with the physical, psychological and mental characteristics and concepts of the pupils' growth phases" which was reported by 14 educators (73.7%) for Psychology courses and
- "knowing the basic concepts of school administration" which was mentioned by 8 educators (50%) for Education foundation and administration courses.

In the interviews, all participating educators mentioned the importance of the educational courses. An educator mentioned the importance of these courses by saying that:

*“Educational courses played an important role in preparing student teachers professionally”* (E17A).

Many of the educators mentioned some functions of these courses, such as providing student teachers with the required knowledge and skills of planning, teaching and assessment methods and the knowledge of curriculum. These courses provided student teachers with the knowledge of pupils’ psychology; and the knowledge of the educational foundation and school management.

In the interviews, 8 educators out of 19 mentioned that the theoretical frameworks of these courses were good. An educator said, *“these courses have good frameworks”* (E15A).

These courses included a good theoretical contents and practical aspects. An educator said that:

*We could say that the frameworks of these courses are good. The content of these courses is good to some extent. There is a good theoretical part and a practical part for each course* (E16A).

Two educators mentioned that these courses have two guides: one is for student teachers and the another is for educators. An educator said, *“the educator’s guide is well-planned and it has specific aims and objectives. It helps tutors to do their jobs”* (E15A). However, they mentioned that many of the student teachers’ guides are incomplete.

An educator said, *“the educational courses were well planned but the problem was in their implementation”* (E8C). So, the next section deals with the most important weaknesses of these courses.



### 5:3:2:2 Weaknesses of the Pedagogical Courses

Regarding educators' views of "the most important weaknesses in the pedagogical courses", Table (5:19) presents their responses.

**Table 5-19 Weaknesses in the pedagogical courses as reported by educators**

Categories	Subcategories	n	%
All courses (66 educators)	Insufficient resources to carry out the practical work	21	31.8
	References of these courses were irrelevant and not enough	19	28.8
	Some aspects of content of these courses were out of date	10	15.2
	Not linked to the reformed general education in the schools	9	13.6
	A repetition in the content of some courses	8	12.1
	Huge theoretical content, limited time for practice	7	10.6
	Did not study problems that exist in schools	4	6.1
	Were not related to teaching science	3	4.5
	Not related and integrated	2	3.0
	No integration of the education courses and subject-matter courses	2	3.0
Curriculum and methodology courses (31)	One course for science teaching methods was not enough	4	12.9
	Training student teachers to use technology in the first year was not enough	3	9.7
	The aspects of the new technology was little	2	6.5
Psychology courses (19)	Required equipment was not available in the psychology laboratory	4	21.1
	Educational Psychology course contained out of date learning theories	3	15.8
	No content about sociological psychology	2	10.5
	No aspects about epistemological psychology	2	10.5
	The timing of teaching the research foundation and statistics course was not appropriate	1	5.3
Education Foundation & Administration Courses (16)	There were no aspects about classroom management	2	12.5
	Education foundation course did not contain educational foundation aspects	2	12.5

n: number of responses for each item, %: percentage = number of responses for each item/ total of respondents

In the questionnaire, the weaknesses of pedagogical courses most frequently mentioned by educators were:

- insufficient resources to carry out the practical work (n=21/ 31.8%);
- references of these courses were irrelevant and not enough (n=19/ 28.8);
- some aspects of content of these courses were out of date (n=10/ 15.2%);
- these course were not linked to reformed general education in the schools (n=9/ 13.6%).

In an interview, an educator said, "although these educational courses are very important for preparing prospective teachers, they have some weaknesses" (E18A). In the interviews, the educators reported some weaknesses in these courses.



For example, many of them mentioned the repetition as a major weakness of these courses (this point is addressed in the practicum aspects).

12 educators reported that these courses had a huge theoretical content. An educator expressed his opinion about the huge content of these courses by saying:

*The density of content of these courses negatively affected the quality of delivery. This resulted in tutors' use of only lectures to teach these courses instead of varying the teaching methods. This was to complete teaching these courses in the provided time. Thus, the exams became the only method to assess student teachers. So, the research and inquiry choices were absent in this huge quantity of content and use of exams (E2C).*

The insufficient time provided was mentioned by all interviewees as a major obstacle facing the effective delivery of these courses. An educator said that *"the educational courses had a huge content and the provided time was really not enough"* (E19A).

Some educators (n=4) mentioned that the educators mainly used lectures in teaching these courses and exams in evaluating them. An educator said, *"exams were used in the college to measure the memorisation of knowledge but this is not acceptable in the university education. The evaluation system in the colleges should be reconsidered"* (E15A).

All educators also reported the limited facilities and resources as a major difficulty. For example, they mentioned: *"references were irrelevant and limited, there were few computers, scientific journals were not available, and facilities provided for activities were not sufficient"*. An educator stated that *"the educational courses were well-planned but the problem was with the facilities and resources of the college"* (E15A). An educator mentioned that *"there were no films at all provided to my courses"* (E16A). The educators mentioned also that the number of tutors was not enough (n=8). Another educator expressed the problem of the shortage in the staff number by saying:

*The number of staff was not enough to teach these courses. We had to gather two or three groups in one class to be taught by one tutor. In this case, there were more than 40 or 50 student teachers in the same class. This of course negatively affected the implementation of the practical part of these courses especially the Science Teaching Methods Course, which required few numbers of trainees in each group (E8C).*

Another educator said *“how can one tutor follow, supervise and advise all of these student teachers during the practical sessions?” (E9C).*

One educator mentioned the limitation of the elective courses offered. He said, *“three elective courses are really not enough. This does not give student teachers the opportunity to choose” (E14P).* He added, *“in some semesters, only one course is provided. Where is the opportunity to choose of choice?” (E14P).*

In the questionnaire (Table: 5:19), some educators mentioned that there were **other weaknesses related to the curriculum and methodology courses.** These were: *“one course for science teaching methods was not enough” (n=4/12.9%) “the aspects of the new technology were little” (n=2/ 6.5%), and “training student teachers to use technology in the first year was not enough” (n=3/ 9.7%).*

In the educators' interviews, some educators mentioned that “Science Teaching Methods Course” had a huge theoretical and practical content. Examination of the syllabus of this course indicated that this course had seven large units of theoretical aspects and another seven units of practical content. It really has a lot of aspects in each unit. For example, the aspects of the theoretical units are illustrated in Table (5:20).



**Table 5-20 The theoretical units and aspects of the Science Teaching Methods Course**

Units	Aspects	Contact hours
1. The nature of science	The concept of science The characteristics of science The structure of science The scientific processes (basic and integrated) Science, technology and society	4 hours
2. The aims of teaching science	The concept of educational aims The levels of educational aims The sources of extracting education aims The aims of teaching science in preparatory and secondary stages The aims of specialisation in the secondary stage Analysing the aims of science curriculum Classifying the aims of teaching science and identifying their levels	2 hours
3. The methods of teaching science	The concept of teaching method Lecturing method Discussion method The presentation of experiments Experimental method Self-learning method	8 hours
4. Approaches of teaching science	Scientific concept mapping approach Discovery approach History approach Problem-solving approach	4 hours
5. New trends of teaching science	Integrated sciences Environmental education Technology education Health education	4 hours
6. scientific activities	The concept, importance, and kinds of scientific activity Obstacles facing the scientific activities and how to overcome them	2 hours
7. The evaluation of learning and teaching of science	The concept of assessment and evaluation The features and characteristics of good evaluation The methods of evaluation of learning and teaching outcomes of cognitive, affective and psychomotor aspects How to benefit from the result of evaluation in improving the learning and teaching of science The evaluation of teacher's performance based on external criteria and self evaluation	6 hours
Total		30 hours

Clearly, from the table above, the time provided to teach the theoretical aspects of this course, 30 contact hours, is not enough. This course needs more than one semester to be taught. As one of the educators said that *"I have been teaching this course for many semesters and I could not complete all its aspects in just one semester. One semester is really not enough"* (E2C).

In the interviews, some educators mentioned that there were no aspects about the reformed general education in the college's courses. An educator reported that *"I was given to teach*



*the New Trends in the Curriculum (this course is an elective courses). I expected to teach some aspects of the new reformed general education in Oman but there was not any aspect” (E6C). Another educator said, “it is supposed that any development in the general education accords with the teacher education but it does not” (E6C).*

In the educators’ questionnaires (Table: 5:19), some educators also indicated that there were **other weaknesses that related to the psychology courses**. These were:

- “required equipment was not available in the psychology lab” (n=4/ 21.1%),
- “Educational Psychology Course contained out of date learning theories” (n=3/ 15.8%),
- “there was no aspects about epistemological psychology” (n=2/ 10.5%),
- “there was no content about sociological psychology” (n=2/10.5%)
- “the timing of teaching the research foundation and statistics course was not appropriate” (n=1/ 5.3%).

In the interviews, some weaknesses were mentioned. These were:

- “required equipment was not available in the psychology lab” (n=4),
- “Educational Psychology Course contained out of date learning theories” (n=2),
- “there was no aspects about epistemological psychology” (n=1),
- “there was no content about sociological psychology” (n=1),
- the timing of teaching the educational psychology course was not appropriate (n=1).

The examination of syllabi of psychology courses indicated that there were not aspects of “sociological psychology” and “epistemological psychology” at all in these courses.

An educator said, *“there were some aspects taught in detail, which are out of date such as learning theories: Pavlov and Skinner. However, there are new epistemological learning theories such as those of Gagne and Asubel which are not included in the educational courses” (E14P).*

In the educators’ questionnaires (Table 5:19), some educators also indicated that there were **other weaknesses that related to Education Foundation and Administration Courses**. Two educators (12.5%) mentioned that “there were no aspects about the

classroom management in the educational courses”. In an interview, an educator said, “*student teachers did not study any aspect of the classroom management. Unfortunately, this aspect is abolished from the School Management Course*” (E15A). He also mentioned that the aspect of communication is taught in two courses: the Education Administration Courses and Education Technology Courses.

In the questionnaire, two educators (12.5%) also reported that “*the Education Foundation Course did not contain educational foundation aspects*”. In an interview, an educator (E15A) named the weaknesses of the Education Foundation Course. These were: “*this course is not related to the education foundation aspects, its objectives are cognitive and its units are separated*. He added that, “*there were no aspects which relate education to society*”. These results were supported by the examination of the syllabus of this course.

### **5:3:2:3 How Can the Pedagogical Courses be Developed?**

Table 5:21 shows the educators’ views on answering the following question: “how the effectiveness of these courses can be improved to meet the requirements of the reformed general education of the Ministry of Education”?



**Table 5-21 Educators' suggestions to improve the pedagogical courses**

Categories	Subcategories	n	%
The content of courses (66 educators)	Redesigning these courses to be related and accordant with the requirements of the Ministry of Education	13	19.7
	Replacing the repeated aspects of these courses with new educational courses and aspects	6	9.1
	Adding "introduction in education course"	6	9.1
	Deleting the repetition of these courses	5	7.6
	Integrating theory and practical parts	5	7.6
	Focusing on the practical parts	5	7.6
	Introducing contemporary educational issues from schools	4	6.1
	New research in the educational fields should be considered to be a part of these courses	3	4.5
	Integrating these courses with subject-matter courses	2	3.0
Resources	Providing related and enough references	21	31.8
	Providing the required resources	11	16.7
	Providing references that related to the reformed education	5	7.6
Teaching these courses	Staff should be given the freedom to organise and teach these courses	8	12.1
Others	Organising seminars and workshops to give a whole picture about the reformed general education to the college tutors	3	4.5
Curriculum courses (31)	Science teaching methods course should be broken down into two courses	5	16.1
	The science teaching methods course and educational technology course should be given more attention	4	12.9
	New trends of teaching science should be included in these courses	3	9.7
	Adding a new course: Information Technology Course	2	6.5
Psychology courses (19)	Development psychology and psychological health course should be broken down into two courses	4	21.1
	Research foundation and statistics should be broken down into two courses	2	10.5
	Adding sociological psychology aspects	1	5.3
	Research foundation and statistics course should be taught in the last year	1	5.3
	Adding epistemological psychology aspects	1	5.3
Education foundation and administration courses (16)	Adding classroom management aspects to the educational courses	2	12.5
	Redesigning the education foundation courses	2	12.5
	Adding new courses: administration and computer; professional development and continuous learning	1	6.3

n: number of responses for each item, %: percentage = number of responses for each item/ total of respondents

In the questionnaire, the greatest-rated of educators' views on how the effectiveness of the educational courses can be improved were:

- providing related and enough references (n=21/ 31.4%);
- redesigning these courses to be related and accordant with the requirements of the Ministry of Education (n=13/ 19.7%);
- providing the required resources (n=11/ 16.7%);
- staff should be given the freedom to organise and teach the courses (n=8/ 12.1%);
- replacing the repeated aspects of these courses with new educational courses and aspects (n=6/ 9.1%);
- adding introduction in education course (n=6/ 9.1%).



In the interviews, the educators reported the importance of overcoming the mentioned weaknesses. For example, they indicated the following points, which could help to develop educational courses:

- focusing on the practical aspects,
- minimising the theoretical aspects,
- offering the required resources and facilities,
- modernising and increasing the references,
- integrating subject-matter courses with educational aspects,
- using a variety of teaching and evaluation methods,
- reviewing the frameworks of these courses every two years,
- redesigning these courses to link them with the schools' requirements.

For example, with regard to redesigning the educational courses to link them to the schools' demands, some educators suggested that it is crucial to include the philosophy of the developed general education in the college's programmes. An educator asserts that "*a coordination between the Ministry of Education and the Ministry of Higher Education must be established*" (E7C). Another educator said that:

*To develop the science education programmes, the philosophy, developments and characteristics of the reformed general education and its trends should be an important part of these programmes. Tutors and student teachers should have a clear picture of this reform (E1C).*

Another educator reported that:

*This (redesigning of the educational courses) should be done to link these courses to the requirements of the Ministry of Education (E18A).*

In addition, some educators mentioned that educators should be given the freedom to choose the most beneficial aspects for student teachers to study. As an educator stated that:

*To develop these courses, educators must be given the flexibility to choose from, change, and add the most beneficial aspects for student teachers to the syllabus' description (E7C).*

In the interviews, the importance of using ICT in teaching the college's courses was reported by three educators. One of the educators said: *"the delivery of these courses should depend on ICT"* (E14P). Another educator reported that *"the use of technology must become one of the priority methods in delivering these courses"* (E16A). Another educator said: *"necessary technology should be offered and this technology must be used to teach these courses especially "Science Teaching Methods Course"* (E7C).

Three educators mentioned the importance of the tutors in delivering these courses. One of them said, *"to develop the college's courses, we should not only consider the programmes' components but the tutor (the teachers' teacher) and this should come in the beginning of any programme's development"* (E18A). Another educator said, *"I see that the credit hours of each course is enough but what is needed is the effective role of the tutor"* (E12P). He added, *"the successful education college depends first on its tutors"* (E12P).

Some interviewees (n=4) suggested introducing a new course. This is the Introduction in Education Course, which should be taught, in the first year. An educator said *"in other countries, there is generally a course taught in the first year called "Introduction in Education". Such a course should be introduced in the Omani colleges"* (E18A). Another educator said, *"this course contains the basic concepts of the curriculum, psychology, and administration and education foundation. This course is a basis for all the educational courses"* (E16A).

Two educators suggested adding another new course. This is "the history of education". An educator said, *"how can student teachers graduate from an education college without studying the Oman's education history and the education history in general"* (E18A).



In the questionnaire (Table 5:21), there were **some suggestions that related to the curriculum courses**. These were:

- the Science Teaching Methods Course should be broken down into two courses (n=5/ 16.1%);
- the Science Teaching Methods Course and educational technology course should be given more attention (n=4/ 12.9%);
- new trends of teaching science should be included in these courses (n=3/ 9.7%);
- adding a new course: Information and Technology Course (n=2/ 6.5%).

In interviews, some educators (n=3) mentioned that “Science Teaching Methods Course” should be taught in at least two semesters. Two educators suggested introducing a new course. This is the Information Technology Course. An educator said:

*As the new technology has become to be very important in the teaching and learning of science, it is crucial to introduce a new IT course to the college’s programmes. This course includes all the knowledge of the new IT aspects and how to use it in the teaching (E7C).*

In the questionnaire (Table 5:21), there were **some suggestions that related to the psychology courses**. These were:

- Development Psychology and Psychological Health Course should be broken down into two courses (n=4/ 21.1%),
- research foundation and statistics should be broken down into two courses (n=2/ 10.5),
- research foundation and statistics course should be taught in the last year (n=1/ 5.3),
- adding sociological psychology aspects (n=1/ 5.3),
- adding epistemological aspects (n=1/ 5.3%).

In the interviews, some suggestions were also reported. These were:

- providing the required facilities to the psychology labs,
- The Development Psychology and Psychological Health Course should be broken down into two courses,
- adding sociological psychology aspects,
- adding a new aspect, i.e. psychology guidance,
- adding epistemological aspects,

An educator said, “*there are new learning theories such as Gagne and Asubel’s theories that should be added to the educational courses*” (E14P).



In the interviews, two educators mentioned that the learning difficulties' aspect that should be added to the Educational Psychology Course.

In the questionnaire (Table 5:21), there were some suggestions that related to the **Education Foundation and Administration courses**. These were:

- adding classroom management aspects to the educational course ((n=2/ 12.5%);
- adding new courses: Administration and Computer Course ; Professional Development and Continuous Learning Course (n=1/ 6.3%);
- redesigning the education foundation course(n=2/ 12.2%).

In the educators' interviews, there were some suggestions. These were:

- adding an aspect about classroom management to the educational courses,
- deleting the communication' aspect from the School Management Course,
- redesigning the objective and the framework of the education foundation course,
- the education foundation course should be taught in the final year.

## 5:4 Practicum Aspects

The results of the investigation into the importance and effectiveness of the aspects of practicum, as viewed by student teachers, educators and newly qualified teachers, are reported in two sections.

### 5:4:1 The Importance and Effectiveness of the Practicum Aspects as Viewed by Student Teachers

The questionnaire elicited 17 items from the student teachers about their views relating to the importance and effectiveness of the practicum. Table 5:22 presents descriptive statistics of each of the 17 aspects for both scales (*importance* and *effectiveness*): mean ratings of Likert scale responses.

**Table 5-22 The importance and effectiveness of practicum aspects as viewed by student teachers**

Practicum aspects	Importance (mean)	Effectiveness (mean)
Planning competency workshop	3.75	2.25
Instructional strategies competency workshop	3.80	2.13
Management workshop	3.86	2.07
Linguistic skills competency workshop	3.71	1.95
Evaluation competency workshop	3.92	2.29
Curriculum content mastery competency workshop	4.40	2.31
Instructional technology competency workshop	4.40	2.36
Administration duty visits	2.63	2.52
Microteaching sessions	4.14	2.62
Observation teaching period	3.94	2.66
Serial practicum	3.86	3.25
Block practicum	4.43	3.67
College supervisors' feedback	4.45	3.45
The role of principals at schools	3.18	2.24
School environment	4.15	2.96
Participating in the school activities	4.13	2.49
The role of co-operating teacher	4.28	1.56

5-point scale: 1= the lowest, 5= the highest. Student teacher (n)= 271

The student teachers rated practicum aspects “*important*” except “*Administration duty visits*” and “*The role of principals at schools*” which were viewed to be “*average*”. The highest-rated aspects were:

- college supervisors' feedback (4.45);
- block practicum (4.43);

- curriculum content mastery competency workshop (4.40);
- instructional technology competency workshop (4.40);
- the role of co-operating teacher (4.28);

The student teachers regarded the effectiveness of these components lower than their importance. The effectiveness of **all** aspects did not approach *effective* except “*block practicum*” (3.67). The lowest-rated aspects were:

- the role of co-operating teacher (1.56);
- linguistic skills competency workshop (1.95);
- management workshop (2.07);
- instructional strategies competency workshop (2.13);

#### 5:4:1:1 Student Teachers’ Views on Benefits of Practicum

In the questionnaire, 132 student teachers (48.7%) responded to the following question: “what are the greatest benefits of the practicum in preparing you to be an effective teacher”? Table 5:23 shows the analysis of their responses.

**Table 5-23 Student teachers’ responses on benefits of the practicum**

Categories	Subcategories	n	%
Greatest benefits	Gaining teaching skills	43	32.6
	Building up student teachers’ confidence	36	27.3
	Linking student teachers to the real school’ environment	30	22.7
	Mastering science subject content of school’s curricula	27	20.5
	Eliminating student teachers’ anxiety	26	19.7
	Strengthening the teacher’ personality	15	11.4
	Acquiring class management skills	13	9.8
	Practising what we have learned in the college (theoretical part)	12	9.1
	Communicating with school’s teachers and benefiting from them	9	6.8
	Getting used to solving school’s problems	8	6.1
	Preparing effective teachers	7	5.3

n: number of responses for each item, %: percentage = number of responses for each item/ total of respondents

The highest-rated responses of the greatest benefits of the practicum as viewed by student teachers were:

- gaining teaching skills (n=43 / 32.6%);
- building up student teachers’ confidence (n=36 / 27.3%);
- linking student teachers to the real school’ environment (n=30 / 22.7%);
- mastering science subject content of school’s curricula (n=27/ 20.5%) and
- eliminating student teachers’ anxiety (n=26/ 19.7%).



In the student teachers and teachers' interviews, all interviewees (n=17) reported that the practicum is a very important component of any teacher preparation programme. They mentioned that the practicum helps student teachers to do their jobs effectively. For example, a female student teacher said:

*The benefits of practicum were many. For example, one benefit was living the daily school's life in which we could practise what we learned in the college. We could benefit from observing class teachers, teaching a lesson, supervisor's feedback, gaining teaching skills, mastering subject matter and so on (ST8).*

A male student teacher reported the benefits of the practicum by saying:

*Teaching during the period of practicum gave us the chance to study, analyse the school's curriculum, communicate with the school staff, gain teaching skills, and so on. This gave us a good experience before practising the real school work (ST6).*

A female teacher also reported that:

*The role of the practicum was well known. It gave us the confidence to teach, trained us to consider pupils, and introduced us to school curricula. It helped to develop our personalities. It also helped us to understand the pupils (NQT3).*

In the interviews, some newly qualified teachers (n=3) compared the practicum in the Sultan Qaboos University (SQU) and in the Colleges of Education. They said the practicum at the Colleges of Education was much better than at the SQU. At the Colleges of Education, practicum starts in the second year whereas as at the SQU it starts in the final semester. According to the interviewees, graduates from the Colleges of Education are better than SQU graduates especially in the teaching performance. As a female teachers reported that:

*Frankly, through our discussion with the graduates from the SQU, we believe that we are better teachers than they are. Graduates from the SQU were surprised by what we did during the practicum period (NQT4).*

These views are based purely on participants' views rather than experience.

### 5:4:1:2 Student Teachers' Views on the Least Useful Aspects of the Practicum

In terms of the student teachers' views on the least useful aspects of the practicum, 126 student teachers (46.5%) responded to this item (Table 5:24).

**Table 5-24 Student teachers views on the least useful aspects of practicum**

Categories	Subcategories	n	%
Least useful aspects	Administration duty visits	31	24.6
	Workshops	29	23.0
	The role of co-operating teachers	28	22.2
	Microteaching sessions	23	18.3
	Participating in the school activities	14	11.1
	The role of school' principles	9	7.1
	The role of supervisors	8	6.3
	Observation teaching period	7	5.6
	Serial practicum	6	4.8
	Block practicum	4	3.2
Others	Starting practicum from the second year	26	20.6

n: number of responses for each item, %: percentage = number of responses for each item/ total of respondents

In the interviews, some student teachers and newly qualified teachers mentioned that **all** practicum aspects are useful and beneficial but the problem was in organising and accomplishing these aspects. As a female student teacher reported that “*every aspect was useful and beneficial if it was delivered in a proper way*” (ST11). A female teacher also said that:

*All of the practicum aspects were important and useful and I cannot say what the least useful aspects were because we felt that one aspect was very important and effective in a semester but the same aspect was useless and ineffective in another semester (NQT5).*

Accomplishing these aspects depended on providing the required facilities to apply them.

In this regard, a student teacher added that:

*If the needed facilities and resources, such as enough facilities in the colleges, enough number of lessons, enough number of supervisors, small groups of student teachers in a school, good cooperation from the school principal and classroom' teacher and so on, were provided, all practicum aspects would have been useful and effective (ST6).*



**a) Administration duty visits**

Administration duty visits were reported as a one of the least useful aspects of practicum (n=31/ 24.6%) (Table 5:24). Furthermore, in the interviews, the majority of interviewees mentioned that this aspect had little value. As one of the female teachers said:

*I believe that it was a waste of time, money, and effort without any real benefit. This aspect was just identifying the school' staff and filling in a lot of papers. This was about the role of principal, deputy principal and so on. All the things covered in these visits were not related to the role of teacher (NQT5).*

Another teacher said, *“there is no need for seven weeks to know the administrative issues. I think one visit is enough to know these things”* (NQT1).

**b) Workshops**

The workshop aspect was also reported as one of the least useful aspects of practicum (n=29/ 23%) (Table 5:24). Furthermore, in student teachers' and teachers' interviews, respondents indicated that some of these workshops were theoretical and there was a repetition of content in some of them. In addition, there were some aspects repeated in other educational courses and workshops. As one of the male student teachers said *“the majority of workshops' aspects were taught in the educational courses. This made them without any new benefit. I do not know the purpose for this repetition”* (ST2). Another student teacher said, *“workshops were repeated in every semester. The content of these workshops was also the same in the educational course”* (ST3). Table (5:25) presents some examples of repetition of workshops mentioned by the student teachers.

**Table 5. 25 Examples of repetition of workshops mentioned by student teachers**

<b>Name of workshops</b>	<b>Course(s) where repeated</b>
Planning competency workshop	The Curriculum Course
	The Science Teaching Methods Course
Instructional strategies competency workshop”	The Science Teaching Methods Course
Instructional technology competency workshop	The Educational Technology Course
Evaluation competency workshop	The Science Teaching Methods Course
	Educational Evaluation & Psychological Assessment Course



In the student teachers' interviews, a student teacher said, "*some of the workshops were useless. I think they consumed time, money and effort*" (ST3). For example, in responding to the least useful aspects of the practicum, a female teacher criticised the "*Curriculum content mastering competency workshop*" by saying that:

*The curriculum content mastering competency workshop* was delivered in a wrong way. It was supposed to take a unit of school curriculum and to be analysed educationally but the educator demanded us to memorise it (NQT3).

Furthermore, student teachers criticised the role of tutors in delivering these workshops. As one of the respondents indicated that "*educators did not take care to accomplish these aspects accurately*" (ST4). Another student teacher said: "*There were many workshops but there was no attention given to them by the educators in delivering them*" (ST1).

In addition, three student teachers mentioned that, many times, some workshops are accomplished after the school-based practicum.

### *c) Microteaching*

Microteaching sessions were reported by 23 student teachers (18.3%) as one of the least useful aspect of practicum (Table 5:24). Furthermore, in the interviews, all student teachers and teachers criticised the application of the microteaching. A female student teacher said that:

*Although microteaching is one of the most important aspects of the practicum, it was applied in a wrong way* (ST7).

She added, "*there were more than 30 student teachers in the same session*" (ST7). One of the male student teachers mentioned the reasons:

*The poor microteaching' rooms were a major obstacle to accomplishing the microteaching sessions. The teaching in these sessions was traditional. This made microteaching boring and student teachers uninterested and unenthusiastic* (ST4).

Student teachers also mentioned that the school-based practicum could start before starting the microteaching sessions.

#### *d) Supervision*

The role of the supervisor is very important in accomplishing the practicum. In teachers' interviews, a female teacher said that:

*From my experience, if the supervisor was enthusiastic and sensitive to the needs of students, either in the college-based practicum or in the school-based practicum, student teachers would definitely have benefited from the practicum and the practicum would have been very useful and effective (NQT4).*

Another female teacher added that

*We were supervised by many supervisors, some of them were enthusiastic and others were not (NQT5).*

However, the role of supervisors was reported by 8 student teachers (6.3%) as one of the least useful aspect of practicum (Table 2:24). In the teachers' interviews, a male teacher said that:

*Although there was an assessment form that supervisors should follow to assess us during the practicum, there was a difference in the assessment of the same student teacher when evaluated by more than one supervisor (NQT1).*

Another male teacher added that:

*Supervision was different from one supervisor to another. This made us confused and we did not know which was the correct way. There was no agreement between supervisors in evaluating us; everyone had his methods and the evaluation process was different from one to the other (NQT2).*

In guiding student teachers in planning their lessons, supervisors sometimes used a different strategy to that used in schools. As a male teacher stated that:

*The way of planning lessons in the school is completely different from what we were trained to do in the college (NQT4).*



The supervisors came from variety of departments e.g. the Curriculum Unit, the Science Department or other departments. This was criticised by interviewees. A male student teacher said that:

*During the training, I needed someone to help me in delivering scientific content, managing the classroom, and so on. So, the supervisor should be from the Curriculum Unit (ST5).*

Some respondents (n=28/ 22.2%) also reported “the role of the co-operating teacher” as one of the least useful aspects of the practicum (Table 5:24). In interviews, student teachers reported also that co-operating teachers had no defined role in the practicum.

#### *e) Serial and block practicum*

Serial practicum (n=6/ 4.8) and block practicum (n=4/ 3.2%) were viewed as the least useful aspects of the practicum (Table 5:24). In the interviews, the majority of student teachers and newly qualified teachers criticised the organisation and implementation of serial and block practicum. The interviewees mentioned that the benefit from the practicum was limited sometimes. As they mentioned, the reason for this was the poor organisation of the school-based practicum. A female teacher reported that:

*Sometimes, there were more than 40 or 50 trainees in one school. This was because there were 5 to 6 groups of 8 student teachers each. This caused a lot of pressure and problems for trainees, school’s teachers, principals, and supervisors. Sometimes, there was no lesson available to teach for a week. So, it was really a waste of time (NQT2).*

A female student teacher mentioned another factor that reduced the benefit of the practicum. She said:

*School’s teachers and principals treated us as strangers. They did not agree to give us enough lessons. There was no cooperation (ST12).*

In some courses, the block practicum was two or three weeks. This affected the accomplishment of the other courses in the college (subject-matter courses, education



courses and practicum workshops). As female student teacher summarised the problem by saying:

*Each semester was composed of 15 weeks. In some practicum courses, student teacher had to spend two or three weeks in block practicum in the schools. The supervisor had to follow student teachers in these three weeks and he had, at the same time, to teach other courses in the college. In addition, the supervisor also had another group of student teachers to supervise during different three weeks. So, the tutor (supervisor) lost about six weeks from the fifteen weeks. The remaining nine weeks were definitely not enough to accomplish the educational and subject-matter courses which are planned to be taught in 15 weeks. In addition, because of the poor organisation of implementation of the practicum, and because of the holidays, more than six weeks were wasted from each course (ST11).*

Sometimes, the teaching of student teachers was not appreciated by the school teachers. As a male student teacher said that:

*Although, student teachers taught the lessons properly, some of classroom teachers re-taught the lessons. They did not trust student teachers in their teaching. Pupils, in turn, did not trust the student teacher in the next lesson (ST6).*

An interviewee reported an important point that is related to the area of specialisation of Physics/Mathematics. Student teachers who specialised in this area have never been trained to teach mathematics. He said:

*I am going to be a Physics/mathematics teacher and I did not teach any mathematics lesson during the whole practicum (ST3).*

#### *f) The length of practicum period*

Starting the practicum in the second year was mentioned by 26 student teachers (20.6%) as one of the least useful aspects of the practicum (Table 5:24). In the interviews, the majority of student teachers and teachers mentioned that starting the practicum from the second year of their training and lasting for six semesters is really boring, routine and a waste of time, money and effort. In an interview, a male teacher said:

*The length of the practicum is three years. It is really too long a time. It starts from the second year till the fourth year. Student teachers are still young to teach in the preparatory and secondary schools. This negatively*

*affected the effectiveness of the practicum. At this early stage, student teachers are still not prepared enough in subject-matter courses (NQT2).*

***g) Other results***

Some facilities were not available in the schools. Even a place for sitting was not provided.

A female student teacher said that: *“there was no place provided to sit during breaks.*

*Sometime we sat in the laboratory or under the shadow of trees” (ST10).* Also some

schools are at a great distance from the colleges. Another male student teacher reported

that *“sometimes we spent two hours travelling to and from the school” (ST11).*

**5:4:1:3 Student Teachers’ Suggestions to Develop the Practicum**

Regarding the student teachers’ suggestions to developing the practicum to be more

effective and to meet the requirements of the reformed general education of the Ministry of

Education, 129 student teachers (47.6%) responded to this item (Table 5:26).



**Table 5-26 Student teachers' suggestions to develop the practicum**

Categories	Subcategories	n	%
Administration duty visits	Abolishing administration duty visits	14	10.9
Workshops	The content of workshops should be not repeated	19	14.7
	More attention should be paid to the curriculum content mastering competency workshops	14	10.9
	Increasing the workshops of the curriculum content mastering competency	6	4.7
	Implementing the workshops effectively	5	3.9
	Adding a drawing workshop	1	0.8
Microteaching	More attention should be paid to the microteaching	12	9.3
	Abolishing the microteaching from the final year	3	2.3
School-based practicum	Maximising the role of the co-operating teachers	21	16.3
	Specifying the final semester for block practicum	19	14.7
	Supervisors should be aware of their role	16	12.4
	The supervisors should be from the Curriculum Unit	13	10.1
	Starting school-based serial practicum from the third year	13	10.1
	Starting school-based serial practicum from the fourth year	12	9.3
	All colleges must become coeducational	10	7.8
	Allowing student teachers to participate in the school's activities	10	7.8
	Allowing student teachers to participate in the examination work	8	6.2
	Giving student teachers the chance to choose the school of training	7	5.4
	Paying more attention to building up a good relationship between the college and the schools	6	4.7
	Schools' principals should be aware of the importance of their cooperation with student teachers	5	3.9
	Preparing a file for each student teacher during the whole practicum period	3	2.3
	Student teachers must be trained to apply the required teaching and assessment methods	3	2.3
	Abolishing practicum one	2	1.6

n: number of responses for each item, %: percentage = number of responses for each item/ total of respondents

#### *a) Administration duty visits*

The student teachers suggested abolishing Administration Duty Visits' aspect (n=14/ 10.9%) from the practicum (Table 5-26). In the interviews, many of student teachers and teachers (n=9) also suggested abolishing this aspect and some of them suggested shortening it.

#### *b) Workshops*

The most frequent responses of student teachers' suggestions to develop the workshops of practicum to be more effective were (Table 5-26):

- the content of workshops should be not repeated (n=19/ 14.7%) and



- more attention should be paid to the curriculum content mastering competency workshops (n=14/ 10.9).

In student teachers and teachers' interviews, the majority of the interviewees reported that the repetition in some workshops should be deleted. In addition, many of them mentioned that "*the curriculum content mastering competency workshops*" should replace this repetition. To overcome the repetition of these workshops, a student teacher stated that:

*Workshops that combine subject matter and educational aspects should be addressed to eliminate the repetitions in the workshops (ST4).*

Qualitative data from interviews also indicated that these workshops should be taught before the school-based practicum not during or after it (n=3). A male teacher reported that:

*It is supposed that student teachers know how to plan, deliver, and evaluate a lesson, and manage the classroom before the school-based practicum starts. So the workshops should be taught before the school-based practicum (ST7).*

### ***c) Microteaching***

12 responses (9.3%) indicated that more attention should be paid to the microteaching and 3 responses (2.3%) suggested abolishing the microteaching from the final year (Table 5-26). In student teachers and teachers' interviews, the interviewees mentioned that the benefit from microteaching should be maximised by training student teachers to apply the needed skills and providing them with the required facilities such as microteaching laboratories.

### ***d) School-based practicum***

Many responses were addressed to develop school-based practicum. The highest-rated responses were (Table 5-26):

- maximising the role of the co-operating teachers (n=21/ 16.3%);
- specifying the final semester for block practicum (n=19/ 14.7%);
- supervisors should be aware of their role (n=16/ 12.4%);
- the supervisors should be from the Curriculum Unit (n=13/ 10.1%);

- starting school-based serial practicum from the third year (n=13/ 10.1%);

The majority of the interviewees mentioned that to improve the practicum, the length of school-based practicum should be shortened to one year or at most one and a half years. A female student teacher said:

*Starting the school-based serial practicum from the third or fourth year is useful because student teachers should be prepared first in the subject-matter courses then they can go to schools for training (ST10).*

To make the practicum more beneficial and useful, many student teachers and teachers in the interviews asserted that supervisors should be from the Curriculum Unit (science education). As a female student teacher reported that:

*The area of specialisation of student teachers and supervisors should be the same and the supervisor should be from the Curriculum Unit (science education). This is because student teachers want to benefit from his/her knowledge and experience not just in the scientific content but also from the ways of effective teaching, assessment, and managing the learning environment (ST8).*

Another female student teacher added that:

*If the supervisor is not from the science education unit, this will negatively affect the student teachers and make them confused (ST9).*

To make the practicum as useful as possible, many student teachers and teachers (n=8) suggested that all colleges should be coeducational. This helps to increase the number of classes offered to trainees. As a student teacher reported that:

*Making the colleges coeducational is a good solution to many of the practicum problems. All male and female schools can benefit from a decrease in the number of trainees in each school (ST5).*

To strengthen the relationship between the colleges and schools, some interviewees suggested organising workshops and seminars between the Ministry of Education and the Ministry of Higher Education. As a female student teacher mentioned the benefits of this by saying:



*These seminars and workshops will contribute in strengthening the cooperation between the schools and the colleges. This will also suggest solutions for a lot of problems of the school-based practicum (ST12).*

Two of the interviewees also suggested designing a file for each student teacher to make the follow-up of student teachers during the practicum easier and useful. A male student teacher reported that:

*Designing a file for each student teacher for the practicum from the beginning till its end is useful. This file enables supervisors to follow up the student teachers for the whole period of the practicum (ST2).*

One of the interviewees (ST3) suggested that it is necessary that student teachers who are in the area of Physics/Mathematics specialisation should be trained to teach mathematics during the school-based practicum. Another student teacher said: *“a place should be offered for student teachers in the schools. This room is for sitting during the breaks, meeting with supervisors and for discussions”* (ST10).

In interviews, some of the student teachers and teachers (n=3) mentioned that student teachers should be given the freedom to choose their training schools. A male student teacher said:

*The training schools should be chosen by student teachers themselves and should be close to their accommodation. This will contribute to decrease student teachers' weariness and anxiety. This also will solve transport problems (ST1).*



## 5:4:2 The Importance and Effectiveness of the Practicum Aspects as Viewed by Educators

The questionnaire elicited 17 items from the educators about their views on the importance and effectiveness of the practicum aspects. Table 5:27 shows descriptive statistics of each of the 17 aspects for both scales (*importance* and *effectiveness*): mean ratings of Likert scale.

**Table 5-27 The importance and effectiveness of practicum aspects as viewed by educators**

Practicum aspects	Importance (mean)	Effectiveness (mean)
Planning competency workshop	4.23	3.33
Instructional strategies competency workshop	4.53	3.47
Management competency workshop	3.85	3.26
Evaluation competency workshop	4.33	3.18
Curriculum content mastering competency workshop	4.60	3.17
Instructional technology competency workshop	4.28	3.18
Administration duty visits	2.82	3.17
Microteaching sessions	4.58	3.29
Observation teaching period	4.00	2.47
Serial practicum	4.42	3.16
Block practicum	4.75	3.03
College supervisors' feedback	4.52	3.69
The role of principals at schools	3.09	2.15
School environment	4.25	3.26
Participating in the school activities	4.12	2.75
The role of co-operating teacher	4.32	1.44

5-point scale: 1= the lowest, 5= the highest. Educators (n=105)

The educators rated all the practicum aspects “*important*” except “*Administration duty visits*” and “*The role of principals at schools*”. The highest-rated aspects were:

- block practicum (4.75);
- curriculum content mastering competency workshop (4.60);
- microteaching sessions (4.58);
- instructional strategies competency workshop (4.53);
- college supervisors' feedback (4.52);

The educators viewed the effectiveness of these components lower than their importance.

The lowest-rated aspects were:

- the role of co-operating teacher (1.44);
- the role of principals at schools (2.15);

- observation teaching period (2.47);
- participating in the school activities (2.45).

### 5:4:2:1 Educators' Views on Benefits of the Practicum

In the questionnaire, 51 educators (48.6%) responded to the following question: what are the greatest benefits of the practicum in preparing student teachers to be effective teachers?

(Table 5:28).

**Table 5-28 Educators' views on benefits of the practicum**

Categories	Subcategories	n	%
Greatest benefits	Gaining teaching skills	14	27.5
	Linking student teachers to the real school' environment	13	25.5
	Building up student teachers' confidence	12	23.5
	Mastering science subject content of school's curricula	11	21.6
	Practising what student teachers have learned in the college	9	17.6
	Eliminating student teachers' anxiety	8	15.7
	Acquiring class management skills	7	13.7
	Strengthening the teacher personality	5	9.8
	Communicating with school's teachers and benefiting from them	3	5.9
	Getting used to solve school's problems	2	3.9
	Preparing effective teachers	1	2.0

n: number of responses for each item, %: percentage = number of responses for each item/ total of respondents

The highest-rated responses of the educators' views of the greatest benefits of the practicum in preparing student teachers were:

- gaining teaching skills (n=14/ 27.5%);
- linking student teachers to real school' environment (n=13/ 25.5%);
- building up student teachers' confidence (n=12/ 23.5%);
- mastering science subject content of school's curricula (n=11/ 21.6%);
- practising what student teachers have learned in the college (n=9/ 17.6%);
- eliminating student teachers' anxiety (n=8/ 15.7%).

In the interviews, all educators indicated that the practicum is a basic component of any teacher preparation programme. It is very beneficial for preparing prospective teachers. An educator said:

*Practicum is a crucial and essential component of teacher education programmes. Student teachers can practise in a real environment what they have learned in the subject-matter courses and educational courses (E3C).*

Another educator reported that:



*Practicum at the Colleges of Education in Oman is well distinguished in the number of credit hours (26 credit hours). It is 20% from the whole programme. This is a big percentage compared with other teacher education programmes in the Arab countries (E17A).*

Another educator added the following benefits:

*Practicum gave student teachers the opportunity to practice for a long time what they learned in the college. They got used to different teaching situations and to overcome many problems such as weariness, anxiety, administration and communicating with pupils. Practicum trained student teachers to acquire the required teaching skills and so on (E12P).*

Two educators mentioned the importance of the workshops. As an educator said:

*One of the strongest aspects of the practicum is workshops. These workshops should replace the teaching methods courses and other educational courses. These aspects do train student teachers how to plan, teach, assess and evaluate pupils (E9C).*

#### **5:4:2:2 Educators' Views on the Least Useful Aspects**

In the questionnaire, only 28 educators (26.7%) responded to the following question: What are the least useful aspects of the practicum? (Table 5:29).

**Table 5-29 Educators' views on the least useful aspects of the practicum**

Categories	Subcategories	n	%
Least useful aspects	Administration duty visits	10	35.7
	The role of co-operating teachers	9	32.1
	The role of principals	8	28.6
	Microteaching	5	17.9
	The applying of workshops	5	17.9
	Block practicum	4	14.3
	Serial practicum	1	3.6
	Participating in activities	1	3.6
Others	All aspects were important	7	25
	The length of the training period, three years was too long	4	14.3
	The large number of trainees in each school was too many	4	14.3
	The required resources were not enough	3	10.7

n: number of responses for each item, %: percentage = number of responses for each item/ total of respondents

7 educators (25%) said, that all aspects were important (Table 5:29). In the interviews, some educators also mentioned the importance of all the practicum aspects. An educator said, "all these aspects were crucial and should exist in any teacher education programme" (E4C). An educator said, "the practicum component is one of the strongest



*components of the college's programmes if it is implemented in a correct way" (E14P).*

However, they criticised the implementation of these aspects. The following points deal with this.

***a) Administration duty visits***

10 educators (35.7%) rated "*administration duty visits aspect*" as one of the least useful aspect of the practicum (Table 5:29). In the interviews, many educators indicated that "*administration duty visits aspect*" was not useful. An educator reported that:

*Administration duty visits aspect" was not useful. It was a waste of time. Student teachers could learn a lot of administrative issues during the next practicum and there was no need to devote 7 weeks (one day/week) to learn these things. This aspect caused a lot of problems such as crowds in schools, adding another job for tutors, adding work for schools' principals and so on (E19A).*

Another educator said:

*Student teachers need the time spent in "the administration duty visits aspect" in studying subject-matter courses or educational courses (E18A).*

Another educator said that:

*Student teachers could know the administrative matters such as school's files, the role of principal, and the role of other staff, during the serial and block practicum (E13P).*

***b) Workshops:***

5 educators (17.9%) reported the application of the workshops as one of the least useful aspects (Table 5:29). In the educators' interviews, many of them mentioned that some workshops were repeated. For example, an educator said:

*Honestly, there was a repetition in these workshops and some of them repeated many aspects dealt with in the educational courses (E17A).*

Table (5:30) presents some examples of repetition of workshops mentioned by educators.

**Table 5. 30 Examples of repetition of workshops mentioned by the educators**

Name of workshops	Course(s) where repeated
Management Workshop	The School Management Course (E18A)
Planning Workshop	The Science Teaching Methods Course (E4C)
Instructional Strategies Workshop	The Science Teaching Methods Course (E4C)
Evaluation Workshop	Educational Evaluation and Psychological Assessment Course (E11P).

***c) Microteaching***

5 educators (17.9%) viewed Microteaching as one of the least useful aspects of practicum (Table 5:29). In the interviews, some educators mentioned that microteaching was the least useful aspect of practicum. As an educator stated that:

*Microteaching was the most useless element of the practicum because it was not conducted in the correct way. Microteaching means: training student teachers to acquire certain skill in a short time. It requires facilities to film it. These facilities were not available in the college (E9C).*

Another educator said the following about microteaching:

*There were no equipped microteaching rooms. So, student teachers could not see themselves after applying a session of microteaching and therefore, there was no self-evaluation. There were big groups in microteaching sessions, 20-30 student teachers (E5C).*

Another educator said, “sometimes, there were more than 40 student teachers in some micro teaching sessions” (E4C)

When doing experimental lessons, in microteaching sessions, there was a lack of facilities. As an educator mentioned that “it was difficult to get kits from the labs”. So student teachers were not trained to do the experimental lessons in the colleges” (E6C).

***d) The role of principals and co-operating teacher***

8 educators (28.6%) rated “the role of principals” as one of the least useful aspects of the practicum (Table 5:29). In the interviews, some educators indicated that the schools’ principals were not co-operative. An interviewee said:

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*This affected the credibility of evaluation. Specialists in science evaluated student teachers from the point of view of subject matter content and they did not pay an attention to the pedagogical issues (E2C).*

#### ***g) Others***

Four educators (14.3%) mentioned “the large number of trainees in each school was too many” as one of the least useful aspects of the practicum (Table 5:29). In the interviews, an educator gave an example for a big group of student teachers in the practicum. He said, “*this semester, I have 21 student teachers in one school (a group/each year)*” (E5C).

In the interviews, one educator said, “*unfortunately, as student teachers went to the reformed schools to apply the practicum they did not have any idea or knowledge about the reformed general education*” (E6C).

#### **5:4:2:3 Educators’ Suggestions to Develop the Practicum**

In terms of the educators’ suggestions to develop the practicum to be more effective and to meet the requirements of the reformed general education of the Ministry of Education, 68 educators (64.7%) responded to this point (Table 5:31).

**Table 5-31 Educators' suggestions to develop the practicum**

Categories	Subcategories	n	%
Administration duty visits	Abolishing "Administration duty visits"	4	5.9
	"Administration duty visits" might be included in the serial or block practicum	3	4.4
Workshops	The workshops should be not repeated	7	10.3
	Reorganising the workshops in order to increase their effectiveness	4	5.9
	Changing some of these workshops to other educational courses	3	4.4
	Changing "administration duty visits workshop" to "curriculum content mastering competency workshop"	2	2.9
Microteaching	Preparing microteaching laboratories for carrying out microteaching sessions	7	10.3
	More attention should be paid to the delivery of microteaching	4	5.9
School-based practicum	Practicum might start from the third year	8	11.8
	School-based practicum is to be in the final year	6	8.8
	Maximising the role of the co-operating teacher	6	8.8
	Increasing the number of staff to help in the supervision of practicum	6	8.8
	The supervisors should be from the curriculum unit	5	7.4
	Minimising the number of student teachers in each group of the practicum	5	7.4
	Designating the whole final semester for the block practicum	4	5.9
	Allowing student teachers to participate in the exams' work	4	5.9
	Allowing student teachers to participate in activities	3	4.4
	Increasing lessons given to the student teachers in the schools	3	4.4
	Training student teachers to teach using the new teaching methods in the schools	3	4.4
	Focusing on the block practicum rather than serial practicum	2	2.9
	Organising short on-going courses for the practicum supervisors	2	2.9
Others	Designing another framework for the practicum	6	8.8
	Colleges must become coeducational	5	7.4
	Making more seminars to increase the awareness of student teachers, staff and principals of the importance of the practicum	3	4.4
	Training student teachers to produce instructional teaching aids	2	2.9
	Colleges must follow up teachers after graduation for at least one year	1	1.5

n: number of responses for each item, %: percentage = number of responses for each item/ total of respondents

**a) Administration duty visits**

4 educators (5.9%) suggested abolishing "Administration duty visits" and 3 educators (4.4%) suggested that this aspect might be included in the serial or block practicum (Table 5:31). These views were also expressed in the interviews. An educator said, "*we could benefit from the credit hours of this aspect in teaching subject-matter courses and educational courses*" (E12P).

### ***b) Workshops***

The highest-rated responses of educators' suggestions to develop the workshops were (Table 5:31):

- the workshops should be not repeated (n=7/ 10.3%);
- reorganising the workshops in order to increase their effectiveness (n=4/ 5.9%).

In the interviews, many educators mentioned that these workshops must be redesigned. As an educator said, "*redesigning and reorganising these workshops should be done to avoid the repeated aspects in the practicum and the educational courses and to overcome the weaknesses*" (E17A).

Two educators recommended that "Curriculum content mastering competency workshop" should be taught by tutors from educational studies department. As an educator said "*this workshop needs an educational analysis and the tutors from science department could not effectively teach it*" (E8C).

### ***c) Microteaching***

To develop the microteaching, two suggestions were mentioned by educators (Table 5:31).

These were:

- preparing microteaching laboratories for carrying out microteaching sessions (n=7/ 10.3%);
- more attention should be paid to the delivery of microteaching (n=4/ 5.9%).

In the interviews, many educators reported that microteaching should be given more enough attention due to its importance in preparing prospective teachers. An educator said that:

*Microteaching is a very important aspect of the practicum. So, it is very crucial that all facilities needed should be provided. Preparing equipped microteaching rooms is a very substantial thing* (E4C).



The tutors of microteaching sessions should be from the curriculum unit. As one educator reported that:

*If the tutors were from the science department, microteaching sessions will lose their importance and there will be no benefits from the microteaching. So, to effectively apply microteaching sessions, it is necessary that their tutors should be from the curriculum and teaching methods unit (E11P).*

#### ***d) School-based practicum***

To develop the school-based practicum, many suggestions were reported by educators (Table 5:31). The greatest-rated responses were:

- practicum might start from the third year (n=8/ 11.8%),
- school-based practicum is to be in the final year (n=6/ 8.8%),
- maximising the role of co-operating teacher (n=6/ 8.8%),
- Increasing the number of staff to help in the supervision of practicum (n=6/ 8.8%),
- the supervisors should be from the curriculum unit (n=5/ 7.4%),

In the educators' interviews, there were some suggestions: decreasing the number of trainees in the schools, focusing on the school-practicum in the final year, and the block practicum might be in the final semester.

Many educators in the interviews suggested starting the school-practicum from the third year. As an educator said, "*the third year is for training in the preparatory schools and the fourth year is for training in the secondary schools*" (E11P).

Few educators suggested recruiting other staff for supervising the school-based practicum instead of college tutors. As an educator stated that "*this (recruiting other staff) will make tutors able to teach their courses in the colleges and there will be no time wasted*" (E5C).

Many educators also mentioned that student science teachers should be supervised by tutors from the curriculum unit (Science Education), i.e. the area of supervisors' specialisation should be the same of the student teachers. As an educator said:

*If we want to guarantee the greatest benefit from the school-based practicum, the supervisors of student science teachers should be from the Curriculum Unit (Science Education) (E3C).*

Some educators mentioned that co-operating teachers should participate in training and assessing student teachers during the practicum. An educator reported that:

*The co-operating teacher should participate in training student teachers due to his/her experience in the subject matter and teaching (E12P)*

Two educators suggested that the schools' inspectors might participate in supervising the student teachers. An educator said, "*inspectors are very experienced in both scientific knowledge and pedagogical knowledge*" (E14P).

#### *e) Other results*

There were other suggestions mentioned by educators to develop the practicum (Table 5:31). The most-frequent responses were:

- designing another framework for the practicum (n=6/ 8.8%);
- colleges must become coeducational in order to distribute student teachers in male and female schools (n=5/ 7.4%).

In interviews, some educators (n=5) mentioned that, to develop the practicum, a new framework might be designed. As an educator stated that:

*Designing another framework for the practicum that meets the demands of the new reformed general education and overcomes the weaknesses of the current practicum should be outlined. This framework includes the planning, organising, applying, supervision, evaluating, and following the practicum (E16A).*

Some educators mentioned the importance of the quality of the practicum in preparing student teachers. One of them stated that:

*To develop the practicum, it should depend on the quality not on the quantity. Practicum presents 20% from the whole programme. This is a big quantity. Student teachers go early to schools starting from the second year of their training. This seems a big percentage with a low effectiveness. This might cause negative attitudes towards teaching (E10C).*

Some educators (n=4) mentioned that an independent office for the practicum with its staff and management should be established.



## 5:5 Other Results

This section deals with some results that emerged from the two last open-ended questions in questionnaires and interviews. The results of this section are divided into two subsections: the respondents' opinions about the distribution of the credit hours of the components of the programme and general recommendations. In addition, this section deals with the results of the effects of some variables on the student teachers' skills.

### 5:5:1 Respondents' Opinions on the Distribution on Credit Hours of the Programme

To improve the science teacher education programme at the Colleges of Education, there is a great feeling that the balance between the components of the programme should be changed. With regard to the student teachers and educators' opinions on the distribution of the credit hours of the programme, 117 student teachers (43.2%) and 48 educators (45.7%) responded to this item in the questionnaire. Table (5:32) summarises their responses.

**Table 5-32 Student teachers' and educators' opinions on the distribution of the credit hours of the programme**

<b>Student teachers' opinions</b>		
<b>Categories</b>	<b>T</b>	<b>Mean (%)</b>
<b>Specialisation courses: 55%</b>	31 (26.5%)	55
Increasing the credit hours of specialisation courses	86 (73.5%)	65.9
Decreasing specialisation courses	---	---
<b>Professional and cultural courses: 25%</b>	<b>31 (26.5%)</b>	<b>25</b>
Increasing the credit hours of professional and cultural courses	---	---
Decreasing professional and cultural courses	86 (73.5%)	13.84
<b>Practicum: 20%</b>	<b>72 (61.5%)</b>	<b>20</b>
Increasing the credit hours of practicum	15 (12.8%)	26
Decreasing practicum	30 (25.6%)	14
<b>Educators' opinions</b>		
<b>Specialisation courses: 55%</b>	<b>33 (68.8%)</b>	<b>55</b>
Increasing the credit hours of specialisation courses	7 (14.6%)	64.3
Decreasing specialisation courses	8 (16.7%)	47.5
<b>Professional and cultural courses: 25%</b>	<b>33 (68.8%)</b>	<b>25</b>
Increasing the credit hours of professional and cultural courses	10 (20.8%)	30
Decreasing professional and cultural courses	5 (10.4%)	19
<b>Practicum: 20%</b>	<b>39 (81.3%)</b>	<b>20</b>
Increasing the credit hours of practicum	2 (4.2%)	30
Decreasing practicum	7 (14.5%)	13.6

T: total of responses for each categorise, Mean (%): the mean of percentages of each categorise

As indicated in Table 5:32, 31 student teachers (26.5%) and 33 educators (68.8%) indicated that 55% of specialisation courses were good whereas 86 student teachers (73.5%) and 7 educators (14.6%) suggested that more credit hours in this area are needed. They suggested increasing it to 65.9% and 64.3% respectively. In addition, no suggestion for decreasing the percentage of specialisation courses was made by the student teachers whereas the educators (n=8/ 16.7%) suggested decreasing them to 47.5%.

The interviews support this data. The majority of student teachers and teachers (n=15) suggested increasing the percentage of subject-matter courses. One of the female student teachers reported that *“Frankly, I see that the percentage of specialisation courses (55%) was not enough to graduate secondary teachers. It should be increased to 70%”* (ST8). A male student teacher expressed his opinion about increasing the credit hours of subject-matter courses by saying:

*I saw that specialisation courses were not enough.... In addition, these courses were superficial especially when we live in the era of a massive scientific breakthrough* (ST2).

A female student teacher expressed her view about increasing the specialisation courses by saying:

*Subject-matter courses should be increased and education courses must be decreased. In fact, we benefited from the practicum in knowing the science content of the school curricula better than from the college’s subject-matter courses* (ST7).

A female teacher stated that:

*I hope that the subject matter courses will be increased to qualify strong teachers in their field of specialisation* (NQT3).

Other opinions, however, were to keep it as in the College’s document, 55%, (n=2). As a male student teacher said, *“if specialisation courses were delivered in a proper and effective way, there is no need to increase them”* (ST5).



In the interviews, many educators suggested increasing the credit hours of subject-matter courses. An educator said:

*from my point of view, subject-matter courses might be increased to 60-65%. This is because student teachers came from the secondary schools and they were weak in the scientific subjects (E15A).*

An educator mentioned that “*in the college programmes, the percentage of specialisation courses is less than 55%. This is because there are some courses, which are counted, with the specialisation courses and they are not*” (E18A). An educator also mentioned that “*in teacher education programmes for the preparatory and secondary teachers, usually, subject-matter courses’ component is given a high percentage. So, I suggest increasing it to 60% or 70%*” (E6C). Another educator said, “*I feel that student teachers are weak in their subject and I suggest increasing the subject-matter courses to 75-80%*” (E18A).

In the questionnaire (Table 5:32), 31 student teachers (26.5%) and 33 educators (68.8%) indicated that 25% of professional and cultural courses was good whereas 86 student teachers (73.5%) and 5 educators (10.4%) suggested decreasing the credit hours in this field. They suggested reducing them to 13.84% and 19% respectively. No suggestions for increasing the percentage of this field were made by the student teachers whereas 10 educators (20.8%) suggested increasing it to 30%.

In the student teachers’ interviews, the majority of interviewees suggested decreasing the professional courses. A student teacher stated that:

*Professional courses should be decreased. The reason for this is that there is a lot of repetition in these courses. Some aspects taught in these courses do not benefit teachers at all (ST8).*



In the interviews, two educators suggested increasing the credit hours for educational courses. An educator reported that *“more effort should be made to increase the credit hours of educational courses”* (E9C). Another said that:

*The distribution of credit hours of the programme is fine. But I feel there is a need to increase the hours of educational courses. This is because these courses are important in delivering and simplifying the scientific content.* (E6C).

However, many educators suggested decreasing the credit hours of the educational courses.

An educator said, *“I think that the educational courses are more than needed by student teachers. I suggest that these courses need to be decreased to 10%”* (E18A).

In the questionnaire (Table 5:32), 72 student teachers (61.5%) and 39 educators (81.3%) indicated that 20% of the practicum courses was good. 15 student teachers (12.8%) and 2 educators (4.2%) suggested increasing the percentage of practicum. They suggested increasing it to 26% and 30% respectively. On the other hand, 30 student teachers (25.6%) and 7 educators (14.5%) reported the need to decrease the percentage of credit hours of practicum. They suggested reducing it to 14% and 13.6% respectively.

In the interviews, some educators suggested decreasing the credit hours of the practicum.

An educator said:

*The length of practicum is too long and its percentage is big. This makes student teachers bored. So, we demand decreasing the practicum' credit hours. This will solve a lot of problems such as offering time to teach other subject-matter courses and educational courses* (E19A).

An educator mentioned that *“the distribution of the credit hours of the colleges programmes is good”* (E5C) but he added that:

*Although this distribution is good, there were some voices (opinions) which call for decreasing the practicum. From my experience in Egypt, Yemen and Oman, this percentage is good* (E5C).

## 5:5:2 The General Suggestions:

Regarding student teachers and educators' responses to other suggestions that they felt might contribute to improving the science teacher programme at the Colleges of Education, 87 student teachers (32%) and 59 educators (56.2%) responded to this item (Table 5:33).

**Table 5-33 Student teachers' and educators' suggestions to improve the science teacher programme**

Student teachers' suggestions (n=87)			
Categories	Subcategories	n	%
Specialisation courses	Deleting the repetitions in these courses	12	13.8
	Providing the required equipment to the scientific labs	11	12.6
	Teaching specialisation courses by using the English Language	8	9.2
	Training student teachers to acquire experimental skills that are required in the schools	8	9.2
	Providing student teachers with the subject-matter content required in the reformed schools	5	5.7
	Changing elective subject-matter courses to compulsory courses	5	5.7
	Studying specialisation courses deeply	4	4.6
	Arranging scientific field trips for student teachers	2	2.3
	Increasing the credit hours of integrated science	2	2.3
Other	Increasing the credit hours of English	9	10.3
	Increasing the educational researches to develop the college's programmes	3	3.4
	Benefiting from the teacher preparation programmes in the developed countries to develop the college's programmes	2	2.3
	Applying democracy in administrating the colleges and considering the student teachers' opinions	1	1.1
ICT	Using ICT in training student teachers	13	14.9
	Training student teachers to use ICT in their teaching of science	15	17.2
Educators' suggestions (n=59)			
Specialisation courses	Integrated aspects of science should be important components of the college's programmes	5	8.5
	Science, technology and society must become important aspects in training student teachers	5	8.5
	Paying more attention to the practical work of the specialisation courses	4	6.8
	Student teachers should study the school science curriculum in the college more deeply	3	5.1
	Arranging scientific field trips for student teachers	1	1.7
Others	Increasing the period of study to five years instead of four years	10	16.9
	Continuous review should be done to review the college's programmes	6	10.2
	Doing interviews before accepting student teachers to study in the colleges to know their attitudes and interests	6	10.2
	Teacher programmes in the developed countries should be taken as a basis to develop the college's programmes	5	8.5
	Paying more attention to the activities in the colleges	3	5.1
ICT	Using ICT in training student teachers	18	30.5
	Training student teachers to use ICT in their teaching of science	14	23.7

n: number of responses for each item, %: percentage = number of responses for each item/ total of respondents



Student teachers and educators' other suggestions can be classified into: specialisation courses, ICT and others. The highest-rated recommendations suggested by the student teachers to develop the specialisation courses were:

- deleting the repetitions in these courses (n=12/ 13.8%),
- providing the required equipment to the scientific labs (n=11/ 12.6%),
- teaching specialisation courses by using the English Language (n=8/ 9.2%),
- training student teachers to acquire experimental skills that are required in the schools (n=8/ 9.2%).

In the interviews, many student teachers (n=8) were concerned with the repetition of some aspects of subject-matter courses. As a female teacher reported:

*The percentage of distribution of the subject matter, educational and practicum courses was not a problem but the main problem lies in the content of these courses. There was a lot of repetition in all of the three components (NQT3).*

A male student teacher named some courses, which have some repeated aspects such as subject content. He said, *“there were some aspects, which were repeated in Physics 1, Physics 2, Physics 3 and new physics”* (ST3).

Three of the interviewees mentioned that the elective courses in the specialisation field should be changed to compulsory courses because the content is very important for them.

A student teacher named these courses: *“Electronics, Nuclear Physics, Statistical Physics”* (ST5). He said, *“these courses should become compulsory courses”* (ST5).

In addition, three interviewees said, some subject-matter courses were not related to the school curriculum. A student teacher said:

*Some subject-matter courses were not related to the school curriculum.” It is important to link the college’s subject-matter courses with the school’s curriculum (ST10).*



Furthermore, some of the student teachers and newly qualified teachers said that they hoped to be taught English as a medium of instruction. A female teacher expressed her idea by saying:

*We would like to be taught through the English Language. This is because the majority of the new references and the Internet are in English. As science teachers, we should read in English and develop our knowledge (NQT3).*

However, a female teacher replied to this by saying:

*I do not approve of using English in teaching college's courses because we are Arab and the language used in schools is Arabic (NQT4).*

Another female teacher had another opinion. She said:

*As long as English has become an international language which is used in the Internet, technology, research, and the majority of the references, it is important then to use English in teaching some college's courses, if not all of them (NQT5).*

In the questionnaire, the highest rated educators' suggestions to develop the specialisation courses were: "Integrated aspects of science should be important components of the college's programmes" (n=5/ 8.5%) and "science, technology and society must become important aspects in training student teachers" (n=5/ 8.5%).

There were other recommendations. The highest-rated recommendations suggested by student teachers were: "Increasing the credit hours of English" (n=9/10.3%) and "Increasing the educational researches to develop the college's programmes" (n=3/3.4%) whereas the highest-rated recommendations mentioned by the educators were:

- increasing the period of study to five years instead of four years (10/ 16.9%);
- continuous review should be done to review the college's programmes (n=6/ 10.2%);
- doing interviews before accepting student teachers to study in the colleges to know their attitudes and interests (n=6/ 10.2%);
- teacher programmes in the developed countries should be taken as a basis to develop the college's programmes (n=5/ 8.5%).

Three student teachers in the interviews, recommended that an Arabic Language Course and Islamic Studies Course should be added to the college's programme as general literacy courses for all areas of specialisations.

Furthermore, three educators in the interviews suggested increasing the period of study to five years instead of four years. For example, one of them said: *"in order to improve teacher education programmes, the period of training should be increased to five years"* (E15A). Another educator reported that *"some educationalists request that teacher education programmes are to be five-year programmes. The final year is for the practicum"*. He added that *"this will solve a lot of problems"* (E17A). Two educators suggested a structure of the five-year programme as following:

- three years are for studying specialisation;
- one year is for studying professional courses;
- last year is for the practicum.

In the interviews, some educators (n=3) mentioned that student teachers should be assessed and interviewed before starting their training in the colleges. An educator said, *"this assessment and interviews are meant to know their attitudes towards the teaching job and to recognise their personalities"* (E119A).

Two educators suggested paying attention to the quality of training. For example, an educator said:

*Matriculating a small number of student teachers and educating them very well is better than matriculating a big number of student teachers trained less well".* He added, *"the entry grades should be high. This is because there is a strong positive correlation between the academic acquirement and intelligence"* (E12P).



### **5:5:3 The Effects of some Variables on Student Teachers Skills**

This section examines the effects of some variables on the student teachers' perceptions of their teaching skills. This focuses on the following variables: gender, college, specialisation, and grade in the last semester. The use of the required statistical tests shows the following results.

#### **5:5:3:1 The Effect of Gender on the Student Teachers' Skills:**

The use of the t-test to compare the overall mean ratings of the student teachers on the differences between the gender showed that the overall mean skills of female student teachers was significantly higher than the overall mean ratings of male student teacher ( $p < .001$ ) in two aspects. These differences were for the overall means of the teaching skills ( $t = -3.184$ ) and the overall mean of assessment and evaluation skills ( $t = -.927$ ).

#### **5:5:3:2 The Effect of the College on the Student Teachers' Skills:**

The use of ANOVA indicated that there were significant differences between the colleges with regard to the student teachers' perceptions of their skills of teaching, and assessment and evaluation. For multiple comparisons, the Scheffe Test was used. With regard to the student teachers' skills of teaching, the resulting analysis indicated the following:

- the overall mean ratings of student teachers' perceptions of their skills in College A were significantly higher than the overall mean rating of student teachers' skills in College B ( $p = .005$ );
- the overall mean ratings of student teachers' perceptions of their skills in College C were significantly higher than the overall mean ratings student teachers' skills in College B ( $p < .001$ ), College D ( $p < .05$ ) and College E ( $p = .001$ ) Colleges.



Regarding the student teachers' perceptions of their skills of assessment and evaluation, the results showed:

- the overall mean ratings of student teacher' skills in College C were significantly higher than the overall mean ratings of student teachers' skills in College A ( $p < .001$ ), College B ( $p < .001$ ) and College E ( $p < .001$ );
- the overall mean ratings of student teacher' perceptions of their skills in College D were significantly higher than the overall mean ratings of student teachers' skills in College E ( $p < .05$ );
- the overall mean ratings of student teacher' perceptions of their skills in College F were significantly higher than the overall mean ratings of student teachers' skills in College A ( $p < .05$ ) and College E ( $p < .005$ );

#### **5:5:3:3 The Effect of the Areas of Specialisation on the Student Teachers' Skills:**

The use of ANOVA indicated that there were significant differences between the areas of specialisation with regard to the student teachers' skills of assessment and evaluation. For multiple comparisons, the Scheffe Test was used. The analysis indicated that the overall mean ratings of student teacher' skills in the area of Chemistry/Physics were significantly ( $p < .05$ ) higher than the overall mean ratings of student teachers' skills in the area of Physics/Mathematics specialisation and the area of Physics/Chemistry specialisation.

#### **5:5:3:4 The Effect of the Student Teachers' Grade in the Final Semester on the Student Teachers' Skills:**

The use of ANOVA indicated that there were significant differences between the student teachers' grades in the final semester with regard to their skills of teaching, and assessment and evaluation. For multiple comparisons, the Scheffe Test was used. In terms of student teachers' skills of teaching, the resulting analysis indicated that the overall mean ratings of

the skills of student teachers who were in grade B were significantly ( $p < .05$ ) higher than the overall mean ratings of skills of student teachers who were in grade C.

In terms of student teachers' skills of assessment and evaluation, the results indicated: that the overall mean ratings of skills of student teachers who were in grade B were significantly ( $p < .05$ ) higher than the overall mean ratings of skills of student teachers who were in grade C ( $p < .005$ ).

## 5:6 Summary

Regarding the science teacher education programme at the Omani Colleges of Education and based on the findings of this investigation, the following conclusions have been found:

1. In general, approximately 86.96% of the competencies were rated to be average i.e. not competent whereas only 10.87% of these competencies were considered to be competent and one competency was viewed to be not competent (see table 5:34).

**Table 5:34: Summary of the student teachers' competencies \***

Competencies	Not competent	Average	Competent	Total
Teaching	1	14	5	20
Assessment and evaluation	--	11	--	11
Problem solving	--	15	--	15
<b>Total</b>	<b>1 (2.17%)</b>	<b>40 (86.96%)</b>	<b>5 (10.87%)</b>	<b>46 (100%)</b>

\* This table is based on tables 5:1, 5:5 and 5:8.

2. The results indicated that student teachers had positive views about experiential learning methods. However, the majority of responses indicated that student teachers could use the experiential learning methods to a limited extent but not effectively.
3. All the student teachers' responses about the new trends of using different assessment tools to assess pupils in science were positive but the majority of responses indicated that student teachers could use different assessment methods to a limited extent but not effectively.
4. This study indicated that student teachers held positive views about problem-solving approach as a science teaching methods. However, there is a strong indication that the Omani Colleges of Education do not equip student science teachers with the practical conception of this approach.
5. Student teachers mentioned many benefits of using ICT in teaching and learning science but there is a strong indication that the Colleges of Education do not prepare student science teachers effectively to use ICT in their teaching.

6. The results indicated that the pedagogical courses are important for educating student teachers but there is a strong indication that the effectiveness of delivery of these courses at the Omani Colleges of Education was invariably lower than the means for their importance.
7. The study results indicated that the practicum is an important component in teacher training programmes. However, the effectiveness of all the practicum aspects at the Omani Colleges of Education was lower than the importance of these aspects.



**CHAPTER SIX:  
DISCUSSION AND  
RECOMMENDATIONS**

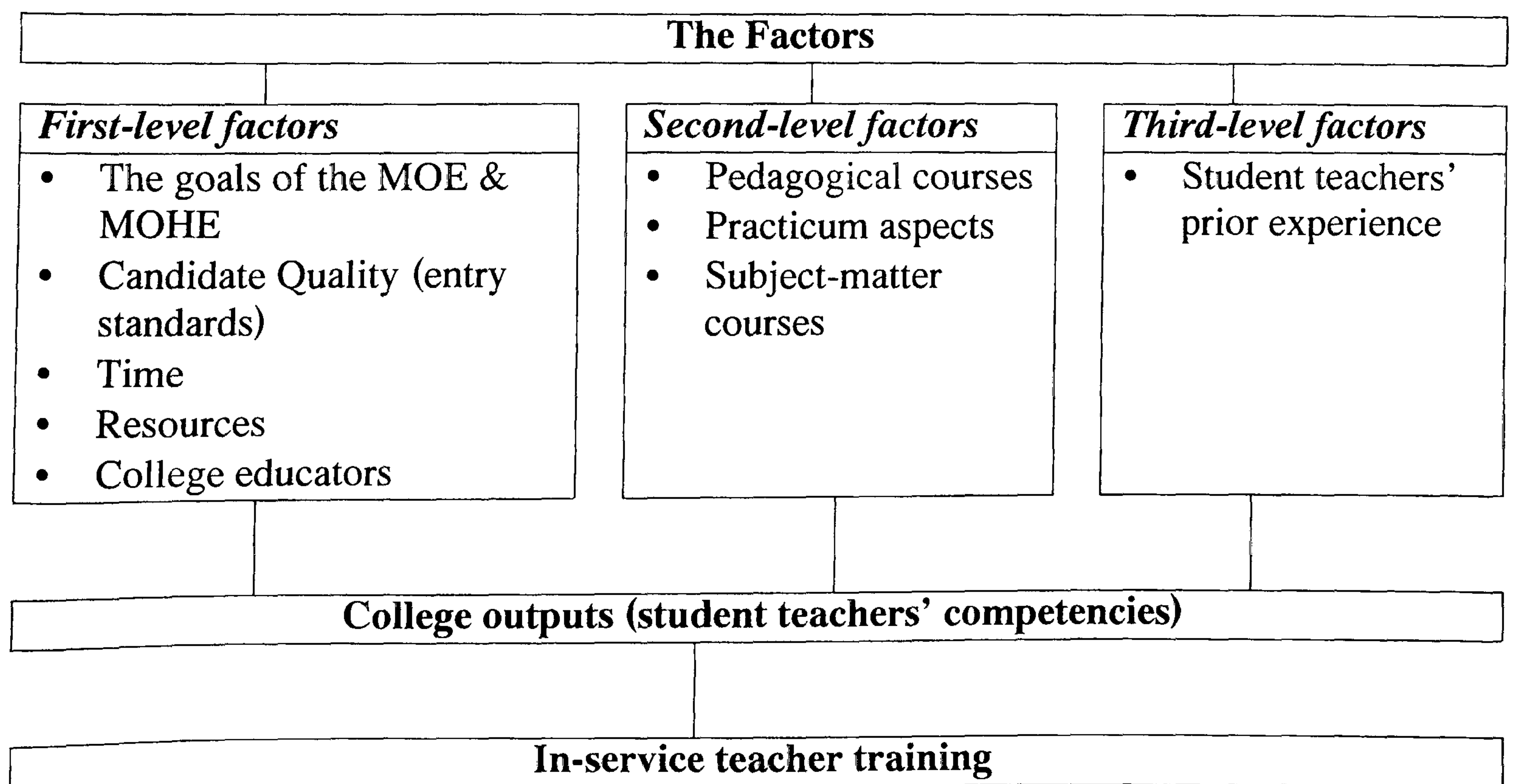
# CHAPTER SIX: DISCUSSION AND RECOMMENDATIONS

## 6:1 Introduction

In general, this research has shown that only a minority of student science teachers' competencies were clearly met on exit from the Omani Colleges of Education's training programmes. This chapter highlights the factors contributing to this situation, and considers the effectiveness of the pedagogical courses and the practicum aspects of their training. In addition, recommendations for the development of the existing science teacher education programme in Oman, recommendations for the Ministry of Education and recommendations for future research are made.

Data collected from participants in this research and written evidence available in documents all point to several interconnected factors limiting the acquisition of the required competencies. This information, supported by the literature reviewed in Chapter 4, has facilitated the grouping of these factors into three main categories, as shown in Figure 6:1.

**Figure 6:1 Factors affecting the acquisition of the required competencies by student teachers**



On the basis of Figure 6:1, discussion is divided into three main sections: factors affecting the acquisition of the required competencies (the first-level, the second-level, the third-level), student teachers' competencies and in-service teacher training. This provides a useful model for the analysis of the data collected by this research.

## **6:2 Factors affecting the acquisition of required competencies**

### **6:2:1 The First-Level Factors:**

#### **6:2:1:1 Goals**

The goals of the Omani Ministry of Education clearly address the development of science education for all pupils throughout the reformed system. It recommends an increased emphasis on teaching and learning methods such as hands-on activities, experiments, collaborative learning, out-of-school trips and visits, games, self-learning, experiential learning methods such as a problem-solving approach, and developed and assorted assessment tools. It also strongly emphasises the use of ICT in the teaching and learning of all subjects and particularly science (Ministry of Education, 1995, 1999a, 1999b). Also there are clear recommendations provided by the Ministry of Education to Teacher Education Programmes with regard to training student teachers. The Ministry of Education states that “*teacher Colleges of Education should ... provide a firm basis for teaching the new programmes*” (Ministry of Education, 1995, A3-18). It also confirms that “*It is ... essential that those graduating from the Teachers' Colleges of Education understand technology and, in particular, be practised in how to teach with technology*” (Ministry of Education, 1995, p. A9-3).

However, currently the aims of the Colleges of Education (see Chapter 2) do not directly support the achievement of the demands as they do not mention at all the demands of the



developed reform outlined by the Ministry of Education. Furthermore, as mentioned earlier in Chapter two, the teacher education programmes are based on a “Competency-Based Approach”. The competencies, or objectives, which student teachers have to master are classified into five groups: *specialisation competencies, professional competencies, cultural competencies, competencies of continuing professional development and community development competencies* (Ministry of Higher Education, 1996). Only some of these competencies meet the requirements of the Ministry of Education. For example, the professional competencies only address a few learning and teaching methods such as discussion, inquiry, discovery and a problem-solving approach. The section of the evaluation competencies addresses aspects related to achievement tests, assignments, self-evaluation and reports. There are also few competencies addressing ICT. This poor matching could contribute to the poor effectiveness of the training programmes in the Colleges.

In short, the aims of Higher Education do not cover all the aspects needed to cope with the new visions of the Ministry of Education in the reformed system. Thus, teachers who meet these requirements are unlikely to be an outcome of the courses. Since the educational reform requires extensive changes in all the related sectors in Oman, including the Ministry of Education and Ministry of Higher Education, a committee including senior officials from the both Ministries (Education and Higher Education) need to plan and supervise the overall process of improving the current teacher education programmes. The goals of the Colleges must address the demand of the developed reform, both explicitly and objectively. The College’s objectives and competencies should state clearly all the reformed aspects including the specified teaching methods.

To achieve the more experientially-based curriculum and to shift the methodology from a teacher-centred towards a pupil-centred approach based on practical work and ICT, will

require extensive and radical changes to the Omani pre-service training programmes (Ministry of Education, 1995). Thus, this would have impacts on the related aspects of these training programmes: 1) **First Level:** (goals, entry standards, time, resources, educators); and 2) **Second Level:** (training courses, i.e. subject-matter, pedagogical and practicum courses) which directly affect the college's outputs i.e. student teachers' competencies (see Figure 6:1). The goals have been considered (see 6:2:1:1), and the following sections are devoted to a discussion of data related to the other aspects of the first-level section (student candidate, the time, resources and educator).

### **6:2:1:2 Student Candidate Quality**

The overall mean ratings of the competencies of female student teachers is significantly higher than the overall mean ratings of the competencies of male student teachers ( $p < .001$ ) in two aspects: the teaching competencies and assessment and evaluation competencies. This might be attributed to the entry level of female student teachers which is often higher than the entry level of male student teachers (Ministry of Higher Education, 1999). When the female student teachers come to the Colleges they usually have higher academic achievements than the male student teachers, thus, they might be expected to acquire competencies better and faster. This was confirmed by the factor that the overall mean ratings of assessment and evaluation skills of student teachers who were in grade "B" were significantly higher in overall mean ratings for these skills than those who were in grade "C". Another explanation is that the Omani female student teachers might be more motivated in becoming teachers than male student teachers.

As there is a positive correlation between academic achievement and the ability to acquire new competencies, the entry standards to the Omani Colleges of Education need to be modified. The Ministry of Education clearly states that "*a superior teaching force is developed by enrolling high achieving candidates who have a strong desire to become*



*teachers in quality teacher education programmes”* (Ministry of Education, 1995, A8-1).

Thus, the admission standards of student teachers should be considered. Student teachers should be also assessed and interviewed before accepting them to training programmes in the Colleges. The assessment and interviews are meant to evaluate student teachers' attitudes towards the teaching job and to recognise their interests and personalities. Shulman (1987) says most of the current education reforms rest on the call for greater professionalisation of teaching, with raising standards for admission into teacher education programmes, establishing state and national examinations for teachers, and better strategies for certification and licensure; implicit in all these reforms are conceptions of teacher competence.

In addition, the Omani Government recognises that the global language of Science and Technology is English, as are the rapidly expanding international computerised databases and telecommunications networks which are becoming an increasingly important part of academic life (Ministry of Education, 1995). Based on this, the reformed education pays strong attention to the use of English as a medium for teaching science and mathematics in the secondary schools (Ibid. 1995). Thus, it is recommended that student science teacher candidates should be also examined for proficiency in English. Increasing student teachers' proficiency in English through providing more credit hours of English courses in the Colleges and using English as a medium for teaching some subject-matter courses (SQU, 2002) and pedagogical courses is also desirable. This will also help student teachers to effectively use the Internet sites written in English, the software which use the medium of English, and research written in English e.g. references and scientific and educational journals.



### **6:2:1:3 Time:**

Although the description of the pedagogical courses has theoretical and practical aspects (Ministry of Higher Education, 1998a), the limitation of time was reported as a major factor constraining the effective delivery of the practical components. This is particularly true for the Science Teaching Methods, the Developmental Psychology and Psychological Health and the Research Foundation and Statistics Courses. Trainees had insufficient time to gain practical experience of the new teaching and assessment methods, especially the problem-solving approach. Hewson *et al*, (1999) confirm that the primary factor for inadequate introduction to the specifics of conceptual changes in teaching methods is the time constraint imposed by a three-credit hour methods course. The courses mentioned are three-credit hour courses and need more than one semester to be effectively taught to cover the breadth of content and activities. Hewson *et al*, (1999) argue that more time would allow for the inclusion of more comprehensive perspectives. This too would provide student teachers with a richer variety of opportunities to learn how to teach science. Cochran *et al* (1993) confirm that effective teacher training courses require time.

Thus, the Omani Colleges need to consider the possibility of increasing the length of study to five years instead of four. This could be justified by the need for more time to learn new concepts, gain new skills, research, assess, reflect and develop attitudes. In addition, the extended time would allow student teachers to apply and try new teaching and evaluation methods such as the experimental problem-solving approach and other hands-on activities. This idea is also supported by the literature review; Shulman (1987) insists that teacher preparation programmes require at least five years of higher education (because there is so much to learn). Denmark & Nutter; Scannell and Weinstein, cited in Feiman-Nemser (1990) also support the 5-year programme. Feiman-Nemser (1990) says many teacher education reforms call for adding an extra year(s). The five-year system offers a more

flexible framework and results in better integration of theory and practice. The extended year allows the possibility of greater emphasis on academic preparation and practicum and encourages some rethinking of the professional sequence. Feiman-Nemser (1990) argues that quality programmes require adequate time, but time alone does not guarantee quality. The important question is how that time is spent. The following is the suggested structure of the five-year programme as indicated by some respondents in this study:

- three years are for studying specialisation courses;
- one year is for studying professional courses;
- final year is for the practicum.

This probably would not affect recruitment as training is offered free by the Ministry of Higher Education and student teachers receive financial support from the Ministry.

#### **6:2:1:4 Resources**

There was a strong indication that resources were a significant factor limiting the Omani College's ability to provide effective training: limited and irrelevant references, insufficient number of computers, limited and poorly equipped microteaching laboratories, insufficient laboratories for science and psychology, limited films and programs, are generally less than adequate facilities. This limited the extent to which student teachers were trained to teach using the required methods such as a problem-solving approach, ICT, experiments, field trips and visits, hands-on activities, projects and so on (see section 6:3).

More specifically, the insufficient equipment and resources in the scientific labs limited the practical work of the subject-matter courses and thus practice in experimental skills that are required in the schools. There are also only two computer labs in each college: the Teaching Computer Lab, which is for teaching computer courses and the Open Access Computer Lab. The latter has 46 computers, which are not sufficient to accommodate the growing number of students and staff members in the colleges (student teachers are more than 1,900 in some colleges and staff are more than 150 in each college). In addition, the



other technologies such as software and hardware are also insufficient. The limited resources affect the training of student teachers to use ICT in their teaching. Boulianne and Weston (1987) also identify that the lack of resources (libraries, laboratories, classroom space, etc.) are a crucial factor in poor quality of teacher preparation.

Furthermore, the shortage of academic staff affected the accomplishment of the practical part of the college's courses, especially in the Science Teaching Methods Course, workshops, and microteaching sessions, which require a higher staff/student ratio. Two or three groups are often brought together to be taught by one tutor. This limits opportunities for practical work and discussion.

The insufficient resources in the Omani Colleges could be due to the poor management of these resources within the colleges or inadequate funds allocated to the colleges. This information was understandably not available and needs further investigation. Although the resources are similar in all the six Colleges, the results of this study have indicated that the overall mean ratings of student teachers' skills in some colleges were significantly higher than others. This might be associated with the fact that some colleges could use the facilities and resources available more effectively than others. Thus, the Omani Colleges should first identify the factors which stand behind the insufficiency of resources and then find a solution for this problem.

In conclusion, the Ministry of Higher Education should recognise that successful education courses that train student teachers to use ICT, pupils-centred approaches, experiments, etc, require proper resources. As Cochran *et al*, (1993) point out, effective teacher training courses require money for providing necessary resources.



### **6:2:1:5 Educators:**

This study has indicated that tutors are a crucial influence in delivering the college courses. There was a great awareness that maximising the effectiveness of the training courses depends on the successful role of tutors. However, some College educators were criticised by many student teachers, for example, they were deemed to be partially responsible for the limited training in problem solving and ICT that student teachers received (**those points are discussed latter; see 6:3**).

In addition, many tutors were deemed to be incompetent and that they were directly responsible for the ineffectiveness of the training courses. In Ecuador, a study (Boulianne and Weston, 1987) indicated that professors of the Faculty of Education lacked the competence to teach and they were made accountable for the shortcomings of the training process. Bekalo and Welford (1999) assert that implementing such teacher education programme requires effort from competent educators. Thus, it is important to provide educators with professional development workshops to help them deliver effective training courses. As Calderhead and Shorrock (1997) indicate, training courses are needed to prepare teacher educators in higher education in how best to instruct and support student teachers. Thus, the Omani Colleges of Education need to review and develop their academic staff competencies to implement the relevant new approaches and techniques in delivering effectively the college programmes i.e. they should be trained, for example, to use the developed teaching and assessment methods, and integrate ICT in their teaching. Why educators were deemed inadequate needs further investigation, as answers were not apparent in the data collected. Calderhead and Shorrock (1997) state that further exploration is needed to extend the understanding of training college tutors and thus, to provide useful material for developing courses and activities for them.

The difference between the effectiveness of one educator and another was clearly emphasised by the student teachers and newly qualified teachers. The overall mean ratings of student teachers' skills in some colleges were significantly higher than the overall mean rating of student teachers' skills in others. This might, additionally to the different use of resources as mentioned earlier, indicate that educators' effectiveness in the colleges with a higher level of students' competencies is greater.

As indicated earlier, the Omani reformed education system requires radical changes in pre-service training programmes through effective training courses. Thus, the next sections deal with the effectiveness of the pedagogical and practicum courses of the Omani Colleges of Education (**Level Two**). In addition, some related aspects of the subject-matter courses are also addressed (see Figure 6:1).

## **6:2:2 Second-Level Factors**

### **6:2:2:1 Pedagogical Courses**

#### **6:2:2:1:1 Importance of Pedagogical Courses**

Most of the pedagogical courses were generally deemed to be important by student teachers and educators because they play an important role in preparing student teachers professionally. These courses, as the results of this study have indicated, help student teachers in gaining knowledge of and skills in teaching and assessment methods. In addition, these courses supply student teachers with the knowledge of physical, psychological and mental characteristics and concepts of the pupils' growth phases, and basic concepts of school administration. Grossman and Richert (1988) indicate that the prospective teachers mention the acquisition of general pedagogical knowledge most frequently when they report what they have learned during their years of training. The literature review indicate that this domain of knowledge is crucial to promote effective learning and essential for equipping prospective teachers with concepts needed for



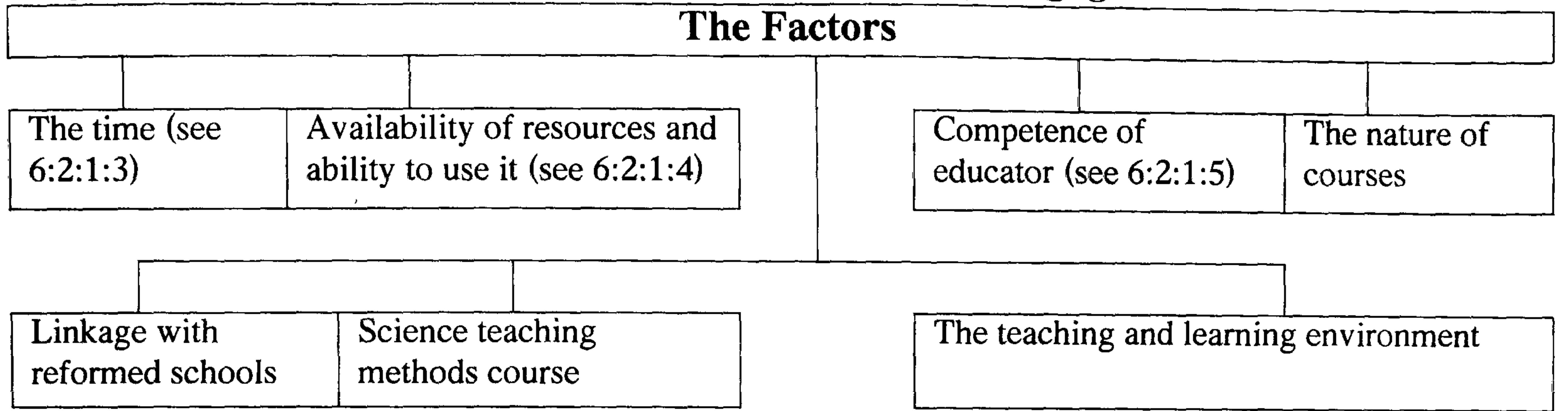
effective teaching (Al Salmi, 1996; Coble & Koballa, Jr, 1996; Goodlad cited in Fullan, 1991; Kelly, 2000; Manouchehri, 1997; Smyth, 1987 and Peterson & Treagust, 1998). Al Salmi (1996) indicates that theoretical courses play a crucial role in the teaching and learning process. Without them it is difficult to understand, for example, adolescent development, the way they think and the way they learn. Teaching theories are needed to accommodate learning styles and teaching strategies that fit the individual needs of students.

Despite the fact that the pedagogical courses are important, the ratings of the **effectiveness** of these courses in the Omani Colleges, as examined by using *t* test, was viewed significantly ( $p < 0.001$ ) **lower** than the **importance** of these courses (see appendix 6). Boulianne and Weston (1987) also recorded a significant gap between the perception of importance and preparation. Al Salmi (1996) too pointed out that the means in the “competence” section were lower than the means in the “importance” section.

The large gap between the importance and effectiveness of the pedagogical courses indicates that the pedagogical courses in the Omani Colleges of Education are not given enough consideration. Bekalo & Welford, (1999) also indicate that pedagogical knowledge in teacher education is not given sufficient attention. Shulman (1986, 1987) also indicates: “pedagogical content knowledge” is not seriously considered. Galluzzo and Craig (1990) indicate that a process evaluation can help to locate any flaws in the procedures or process in the implementation of the programme. In this study, responses to the open-ended questions in the questionnaires and interviews, and document examinations confirmed the conclusion of ineffectiveness of the pedagogical courses and point out some possible factors for this. Figure 6:2 presents some of these factors.



**Figure 6:2 Factors affecting the effectiveness of the pedagogical courses**



**6:2:2:2:2 Effectiveness of Pedagogical Courses**

The time, availability of resources, competencies of educators were discussed earlier (see 6:2:1:3, 6:2:1:4 and 6:2:1:5). The following sub-sections address the other factors (Figure 6:2) and shed light on how the effectiveness of the pedagogical courses could be maximised at the Omani Colleges of Education:

*a) The nature of the pedagogical courses:*

The results presented in this study have indicated that the theoretical aspects of the pedagogical courses were emphasised in favour of the practical component and this is in part to do with historical development of these courses. In addition, many theoretical aspects were repeated. This is seen all over the world. San (1999) indicated that initial teacher training in Japan is also still very theory-based. The results of Boulianne and Weston’s (1987) study indicated that one of the major problems with teacher preparation in Ecuador is the emphasis on content rather than practical application of theory. Fullan (1991) confirms that most student teachers will say that they get too much theory and that it is a waste of time.

Examination of the College documents (Ministry of Higher Education, 1998a) indicated that all the descriptions of the Pedagogical Courses have practical aspects. However, this examination also indicated that the theoretical components are large. Thus, the practical work might be deemed ineffective because of the huge theoretical content and the limitation of time provided to accomplish it (see 6:2:1:3). This of course influences the

preparation of prospective teachers. Fullan (1991) confirms that the theoretical component has little impact on educating effective teachers. Thus, the Omani Colleges should increase the effectiveness of the practical components. In order to do this, it is important to eliminate any redundancy in the theoretical aspects. This will increase time for applying more practical work. Jones (2000) mentions that almost all trainees express a wish for less emphasis on theoretical aspects and more on practical ones. It would be more beneficial to place greater emphasis on practice related subject methodology. To decrease the theoretical content, Grossman and Richert (1988) suggest that educational courses can provide an image of the situation in the classrooms, putting emphasis on survival skills during fieldwork.

In this study, integrating theoretical and practical aspects was mentioned as an important aim for development of the college programmes. Fullan (1991) stresses that the *integration* of theory and practice is a desirable goal for effectiveness of pedagogical courses. Rask (1995) identifies several important issues concerning the linkage between theory and practice, school experience and taught courses. These are:

- the use of simulation experience and group tasks during the taught course; to be effective they must be made real;
- the value of group work with fellow students on the taught courses;
- the importance of developing personal theories throughout the taught courses and how important it is to be aware of underpinning principles of practice;
- a written assignment might be shaped to draw upon issues arising out of practice or taught sessions built around observations and samples gathered in schools together with selected personal readings (pp. 52-53).

In addition, the results of this study have indicated that student teachers were taught some aspects which were regarded to be out of date and irrelevant. For example, in “Comparative Educational Systems Courses”, student teachers studied the old education systems in Japan and in Oman. Student teachers were also taught out-of-date learning



theories within the psychological courses. In addition, student teachers were provided with aspects of school management instead of providing them with classroom management. Fullan (1991) says that most student teachers will say: they get theory that it is irrelevant. Thus, the Colleges should review these aspects and provide student teachers with up-to-date materials that are more relevant and beneficial for the field of teaching and learning.

On the other hand, this study has also indicated that some crucial courses and aspects were not included in the Omani College programmes. These are: an Introduction to Education Course, Information Technology Course, aspects of sociological psychology, psychological guidance, epistemological psychology, classroom management, administration and computer, educational foundation, education and society, learning difficulties, and professional development and continuous learning. At first glance, it seems that all these aspects are important and related to teacher education programmes and especially when mentioned by the College educators who, presumably know what aspects should be included in these programmes. Recently, according to Coble and Koballla Jr, (1996), courses specific to classroom management and the effective use of computers in teaching science have been added to many teacher education programmes. Lederman (1999) also argues that classroom management aspects should be essential parts of teacher education programmes. Thus, the Omani Colleges should study the possibility of adding the mentioned courses and aspects to their programmes.

***b) Linkage between pre-service teacher courses and school curriculum***

This study has indicated that the pedagogical courses at the Omani Colleges were not linked to the reformed general education and this is a serious weakness. Bekalo and Welford, (1999) indicate, that teacher-training courses often suffer because they lack congruence with both the school curriculum and the realities of typical classrooms. Jong and Brinkman (1999) also state that pre-service teacher education programmes still



experience difficulties in bridging the gap between theories taught in these programmes and the classroom reality. For example, Omani student teachers were taught the previous education system and they were not sufficiently exposed to and encouraged to think about the new teaching and assessment methods of the new reformed system, and thus they were reluctant to use them (**student teachers' competencies are discussed latter; see 6:3**). Blanton, 1992; Calder, 1990; Didham, 1991; Landers & Weaver, 1991; Murphy, 1990; Pugach, 1988, cited in Strawderman and Lindsey (1995) all indicate that the competencies most teacher education programmes identify do not facilitate the kind of knowledge base both regular and special education teachers need to function effectively in today's schools. Thus, it is clear that institutions of higher education are not preparing future teachers to meet the demands of schools.

This study has indicated that reforms of teacher education programmes must go hand in hand with school reforms. As Manouchehri (1997) states: simultaneous reform in teacher education must accompany efforts toward school reform, lest they become futile and Calderhead and Shorrock (1997) say that the quality of initial teacher training programmes should be improved to meet the increasing quality demands of the schools and teachers. New teachers need to be able to implement the new vision of the school's curriculum as Coble and Koballa, Jr (1996) argue that teachers are directly responsible for implementing the changes associated with the new reform of science education in the classroom. They demand that science teacher programmes play a major role in preparing effective teachers in order to enact the changes that accompany the new vision of science education.

Thus, in order to prepare effective teachers who are able to cope with the reformed science curriculum, the Omani Colleges programmes should be related to, and accordant with, the demands of the new reform. The philosophy and aims of the reform, the structure of the

new system, the design of the Basic Education Curriculum, and the characteristics of this reform should be important components in the college's courses.

Aspects of new science education of the reform should be essential and integrated components of these programmes. To mention some, these are (Ministry of Education, 1996, 1999a, 1999b): the objectives of science education, theoretical and practical materials of the teaching methods such as experiential learning approaches, hands-on activities and experiments, problem-solving method, out-of-school trips and visits, collaborative learning, self-learning, ICT, games and so on. Assessment strategies such as observation, tests, performance assessment, self-assessment, reports, measurement of higher cognitive skills, interviews, and so on should be also included and integrated in training programmes. Kahle and Boome (2000) also suggest educators and policy makers need to be certain that the integral components, instruction, curriculum and tests of the science education reform, are aligned, and links across these components need to be made in pre-service teacher education.

### *c) Importance and effectiveness of the science methodologies course*

In the "importance" section of the questionnaire, the highest-rated course was the Science Teaching Methods Course. Coble & Koball, Jr, (1996) and Kelly (2000) confirm that such courses are a central element in science teacher preparation programmes for educating pedagogically effective science teachers. However, this Course at the Omani Colleges has a huge theoretical content with little integration between science content and the pedagogical knowledge. In addition, there was not sufficient time for applying the practical work (**the last point was discussed earlier: see 6:2:1:3**). Raizen and Michelshon (cited in Kelly, 2000) also believe that many of the pedagogical strategies employed in science methods courses have limited value because teachers cannot connect the scientific content with the appropriate teaching strategy. The lack of pedagogical content knowledge occurs



because the relationship between science subject courses, which emphasise science content, and science methods courses, which focus on pedagogy and process is not made explicit.

This research highlights that more attention needs to be paid to integrating science content with pedagogical knowledge. This is called “pedagogical content knowledge” (Shulman (1987). The College courses in Oman need to provide student teachers with this kind of knowledge because it is crucial for meaningful learning and effective teaching (Coble and Koballa, Jr, 1996; Geddis, 1993; Grossman, 1989; Grossman cited by Manouchehri, 1997; and Kelly, 2000).

To integrate science and pedagogy, a model or framework of pedagogical content knowledge is very important. Cochran, DeRuter, and King (1993) argue that such a model is effective to educate teachers pedagogically. According to Yager *et al* (1988) the methods course in a teacher education programme serves as a vehicle for content and pedagogy integration (pedagogical content knowledge). Thus, this Course in Omani Colleges should be designed to provide student teachers with strategies of pedagogical content knowledge that would help them to work effectively in the reformed schools. Kelly (2000) states that there is no single model of a science methods course that will be appropriate for all situations, but there may be some general guidelines emerging from several recent initiatives to effect improvement in science teacher education.

Courses and course experiences, and models that could be considered as frameworks for the Omani pre-service teacher programmes have been described in the literature review (e.g. Cochran, DeRuter, and King, 1993; Kelly, 2000 and Manouchehri, 1997). For instance, Cochran, DeRuter, and King’s (1993) model is based on a *constructivist* view of



learning and its application to teaching and teacher education. This model includes four integrated components of “*pedagogy, subject matter, student characteristics, and the environmental context of learning*” (p. 266). To build such a course that combines science content and pedagogy, Alshannag (1998) suggests increasing the communication and collaboration between the science departments and educators through small group discussions. Thus, a collaborative committee formed from the Science Department, the Department of Educational Studies in the Omani Colleges and experienced science teachers from the schools could design a constructive science methods course. Abell and Bryan (1997) confirm that there is evidence that a properly conceptualised science methods course has the potential to familiarise student science teachers with pedagogical subject knowledge and thus improve science education.

#### *d) Teaching and learning environment*

The Ministry of Higher Education (1998a) suggests using different teaching methods such as lectures, discussion, workshops, and experimental work in teaching the College courses and using some different assessment tools such as tests, assignments, reports, summary and practical tests. In addition, the Ministry also recommends using instructional aids in delivering these courses such as OHP, films, slides, ICT, and the Learning Resources Centre. However, the results of this study have indicated that student teachers in the Omani Colleges were taught traditionally, mainly by lectures and assessed traditionally by exams that focus on the memorisation of the massive theoretical content. Furthermore, some educators only use “*reading the content of the courses*” as a method of delivery the college’s courses. Although there were assignments beside the exams in some courses, this study indicated that these assignments were not beneficial, as tutors did not review these assignments with the student teachers. Student teachers were not allowed to see and discuss their assignments again to know what their strengths and weaknesses were. Thus, it is clear that there is a big gap between the descriptions of the College’s courses and the

way of delivery of these courses. In short, student teachers experienced four years of passive, lecture-driven teaching during their training.

The limited use of different teaching and assessment methods might be due to many causes. For example, the nature of courses, which have huge theoretical content, and the available time, obligate the tutors to deliver the content by lectures. Thus, other teaching methods such as discussion, workshops, and research are omitted and, therefore educators can only use exams to assess the memorisation of this huge content. Another factor might be the insufficiency of resources in the Colleges (**this point was discussed earlier: 6:2:1:4**) which limits the use of a range of teaching methods. Another reason might be that the tutors themselves do not know how to use the other different teaching and assessment methods. The final reason emphasised by many student teachers in this study, may be that the educators are not competent (**this point was discussed earlier, see 6:2:1:5**). This point was also confirmed covertly by some educators themselves and was supported by evidence that some educators rarely used the available resources in the colleges such as the Learning Resources Centre.

The limited use of different teaching and assessment methods affects student teachers' abilities to use these methods in their own teaching. Fullan and Stiege (cited in Kelly, 2000) confirm that teachers would teach science the way they were taught; in schools or in teacher education institutions. Hewson *et al* (1999) indicate that prospective teachers' positive views of knowledge and transmissionist views of teaching are influenced by the university model of teaching they experienced in their courses. As student teachers are clearly influenced by the teaching and assessment strategies of the college tutors, further research is needed to examine the relationship between the delivery and evaluation methods of the college tutors and the effective student teachers' skills of teaching.



This research has highlighted that use of variety of teaching and assessment methods is a desirable goal to help improve delivery of the College programmes. This, of course, would help student teachers in their teaching, by modelling good practice. As Alshannag (1998) confirms, student teachers who experienced a wider variety of instructional and assessment strategies in their teacher training courses, such as small group discussions, teaching group projects, group work, and cooperative learning, could use these teaching methods in their teaching.

In addition, as the reformed schools in Oman use a range of teaching and learning methods, it is sensible that Omani student teachers should be taught using the same methods. Manouchehri (1997) states if teachers are to choose the visions offered by a reform, they must be convinced of their values and have exposure to a similar learning environment first-hand as learners. Thus, it is appropriate to recommend that the teaching methods, and assessment and evaluation tools used in the Omani Colleges of Education in all the three components: the subject-matter courses, the pedagogical courses and the practicum, require improvement. This includes using of a range of teaching and assessment methods, which emphasise the relationship between learning and assessment.

#### *e) Conclusion*

In conclusion, to develop the pedagogical courses in the Omani Colleges of Education, there is a need to restructure and redesign the pedagogical courses. To reform teacher education programmes, Strawderman and Lindsey (1995) also recommend restructuring of coursework. According to CIPP model (Galluzzo & Craig, 1990) the role of process evaluation is to identify aspects of the programme that might need adjustment. Thus, the Omani Colleges should redesign and develop the aspects that were deemed to be ineffective in this study. The restructuring should reduce the theoretical aspects and increase the practical components, integrate theory and practice, link the new visions of the



reformed schools' curriculum with the College's curriculum, integrate science and pedagogy, use different and effective teaching and evaluation methods, and add new recommended courses and aspects. One suggested improvement could be the introduction of quality assurance systems to ensure that courses were delivering what they are supposed to deliver.

## **6:2:2:2 Practicum Aspects**

### **6:2:2:2:1 Importance of Practicum**

Quantitative data in this study have indicated that the practicum is an **important** component in teacher training programmes. Most of the practicum aspects were generally viewed by **all** student teachers and educators as important. Fullan (1991) argues that practicum has always been valued more by student teachers due to its importance for professional development. Hewson *et al* (1999) confirm the important and significant role of field experience, supervisors, co-operating teachers, and project staff in assisting prospective teachers gain the confidence they need to teach successfully in schools.

Qualitative data from this study also support this result and confirm that the practicum is a very important and beneficial component for preparing science teachers in Oman. Many benefits were mentioned by the participants. For example, they indicated that practicum helps student teachers to gain teaching skills and knowledge about school curricula. Alshannag (1998), Brooker and Service (1999), Grossman and Richert (1988), Nichol (1993) and Yager *et al* (1988) all indicate that the practicum is a crucial factor in developing both knowledge and competencies of teaching. For example, Nichol (1993) says close involvement with a school equips each student teacher with a set of immediate skills and necessary competencies. Student teachers, in Australia (Tisher, 1990), stated that practicum was the most relevant aspect of their course, helping them to develop realistic perspectives about pupils and their own curriculum knowledge.

In this study, respondents reported that practicum helps to build up the confidence of student teachers and eliminate their anxiety. In Australia too, student teachers also felt that it helps to reduce student teachers' anxiety (Tisher, 1990). Brooker and Service (1999) and

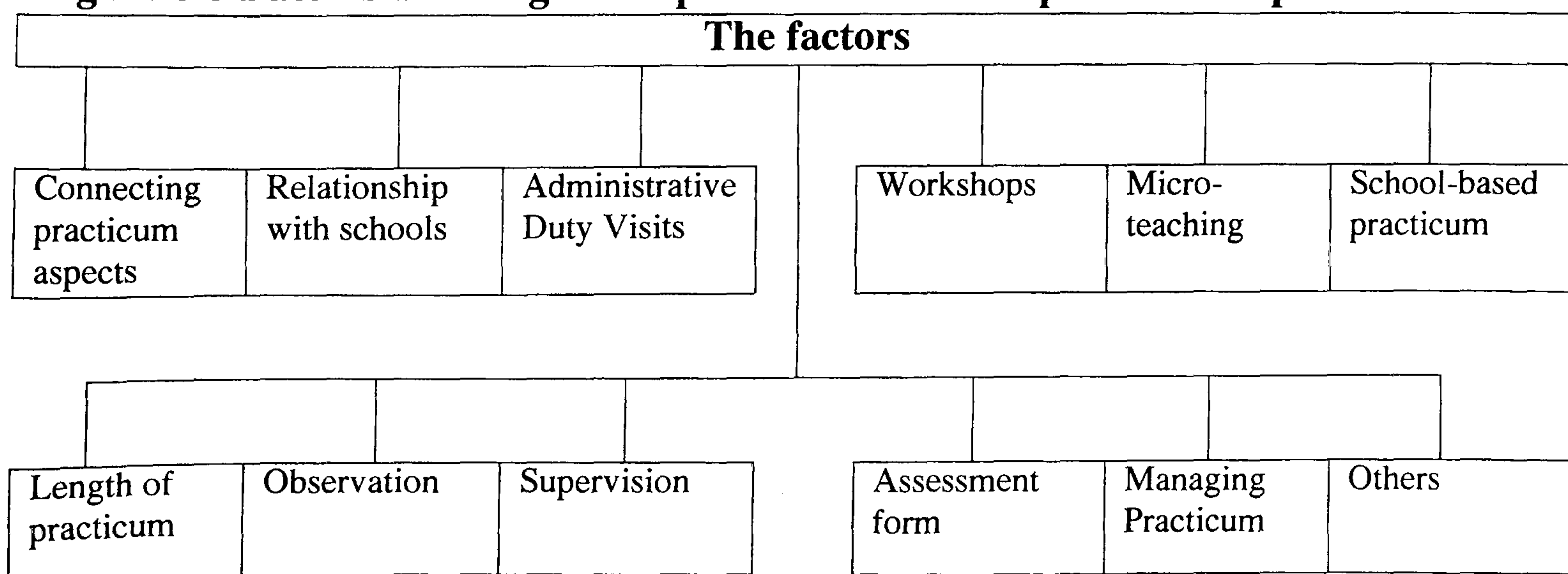
Rothenberg *et al* (1993) report that teaching practice enhances the student teachers' confidence.

The results presented in this study have also indicated that practicum links student teachers to a real school environment. Henry (cited in McIntyre, Byrd and Foxx, 1996) indicates that practicum links student teachers to the real teaching setting; and allows prospective teachers to induct into the existing school environment.

In short, practicum, as this study has indicated and in line with other studies, is a crucial and essential component of teacher education programmes. Student teachers can practise in a real environment what they learn in the subject-matter courses and pedagogical courses. They get used to different teaching situations and learn to overcome many problems such as weariness, anxiety, administration, and communicating with pupils. Practicum also trains student teachers to acquire the required teaching skills and so on.

However, the **effectiveness** of **all** practicum aspects in the Omani Colleges, as examined by using *t test*, was significantly ( $p < 0.001$ ) rated **lower** than the **importance** of these aspects (see appendix 7). There were many factors affecting the implementation of practicum aspects. Some of them are presented on Figure 6:3.

**Figure 6:3 Factors affecting the implementation of the practicum aspects**





#### **6:2:2:2:2 The Effectiveness of Practicum Aspects**

The ineffective implementation of the mentioned factors (Figure 6:3) contributed to an inadequacy of training of Omani student teachers and reduced the benefits of the practicum (see the subsections below). In Ecuador, Boulianne and Weston (1987) indicate that the weakness of the practicum components of a teacher programme is a major cause for weaknesses in training student teachers. Alshannag (1998) reports some factors that would minimise the benefits of the practicum, such as school context, co-operating teachers, teaching loads, teaching out of student teachers' majors, and students' attitudes toward learning science. The following points highlight the above factors (Figure 6:3) in more detail, as they affect the implementation of the practicum in the Omani Colleges and try to shed light on how the effectiveness of practicum could be maximised.

##### ***a) Connecting practicum aspects***

There was an indication that the various aspects of practicum in the Omani Colleges were not effectively connected. Thus, it is not surprising that these pre-service training programmes could fail to achieve their goals. As McIntyre, Byrd and Foxx (1996) confirm, the *disjointedness* of the components of a teaching practice may be responsible for its *ineffectiveness*. They say that many teacher training programmes fail to challenge their students to understand how ideas are connected or related to teaching practice. This, according to Byrd and Foxx (1996), is because pre-service teachers are unable to understand the whole while experiencing the myriad of disconnected areas of the programme. Thus, it is crucial that the different aspects of the practicum in the Omani Colleges should be related in order to increase the effectiveness of practicum.

##### ***b) Relationship with schools***

The results of this study have indicated that the relationship between the Omani Colleges and school staff (principals and co-operating teachers) was weak sometimes. It is not sufficient to put student teachers in schools without paying attention to the relationship with schools in which they will spend their training. Robinson, (1999) states that if this relationship is weak, it is not surprising that schools offer little depth of support to student teachers. Thus, it is important to create a collaborative working environment between the educators, school principals, and co-operating teachers for a successful practicum for the students. This relationship is crucial to ensure effective contact between the teacher training institutions and schools, and thus, to maximise the effectiveness of the practicum (Rask, 1995; Robinson, 1999 & Taib, 1997).

How can the effectiveness of the practicum in the Omani Colleges be strengthened? It is suggested that regular meetings and seminars are held to increase the awareness of student teachers, college staff, school principals and co-operating teachers to reinforce the effectiveness of the practicum. This would enhance the dialogue between the Colleges and schools, strengthen the relationship between them, and suggest solutions for problems that might occur during the school-based practicum. Robinson (1999) considers that a key point to developing teacher education is the enhancement of the dialogue between schools and universities. Thus, the overall impact would be to increase the effectiveness of the practicum for all concerned.

### *c) Administration Duty Visits*

The Administration Duty Visits were seen as one of the least useful aspects of practicum. It was deemed to be a waste of time, money, and effort without worthy benefit. There is no need for seven weeks (a day/per week) to be spent in schools learning about administrative issues. Student teachers can learn a lot about these issues during the serial and block practicum. Time spent on these visits might be needed in studying subject-matter courses



or educational courses. There is a consensus that Administration Duty Visits should be shortened and incorporated into the serial or block practicum.

#### *d) Practicum Workshops*

The intention is that practicum workshops should be very beneficial for student teachers (Ministry of Higher Education, 1996, 1998b), but in this study they were deemed to be less beneficial. Some student teachers viewed these workshops as theoretical. Examination of the description of these workshops (Ministry of Higher Education, 1998b) indicates that they should be accomplished practically. The reason they are viewed as theoretical might be because of the way they are delivered. For example, the results indicated that the Curriculum Content Mastering Competency Workshop was delivered by requiring student teachers to memorise the scientific content. This conflicts with the requirement of this aspect (Ministry of Higher Education, 1998b) which asks student teachers to discuss the elements of the curriculum, and analyse educationally the scientific content of it. The ineffectiveness of the workshops also could be interpreted by that some of these workshops were not taught by educators who are from the Department of Educational Studies. Thus, to increase the effectiveness of these workshops, more attention should be paid to use of appropriate methods during delivery. In addition, they should be taught by tutors who are from the Department of Educational Studies and who are familiar with the most effective and relevant ways of delivery the practical work.

Another major weakness of these workshops was repetition of content. There was a clear indication from the respondents, and confirmed by examination of documents, that these workshops repeated themselves and that the majority of content was repeated in other Educational Courses. So, there is a good case for reorganising the workshops to avoid the repetition.



Although these workshops should take place before the school-based practicum or during it, the results of this study indicate that they were sometimes taught after it. This made them useless because student teachers should know how to plan, deliver, evaluate a lesson, and manage the classroom before the school-based practicum starts (Ministry of Education, 1998b). It would be a good idea to ensure that these workshops are taught before the school-based practicum.

#### *e) Microteaching*

Although microteaching was regarded as one of the most important aspects of the practicum, many respondents criticised the implementation of the microteaching sessions. Poorly equipped microteaching rooms and a shortage of staff were major obstacles to the implementation of effective microteaching sessions (**this was addressed earlier; see 6:2:1:4**).

In addition, poor organisation was seen to be a major obstacle to effective microteaching. For example, student teachers went to the school-based practicum without having been trained sufficiently in the microteaching sessions. This issue is seen as a serious problem because normally student teachers begin their practice by teaching lessons before going to the school. According to the Ministry of Higher Education (1998b), micro-teaching sessions should be used to train student teachers in the basic teaching competencies in order to apply them in the school-based training. However, the implementation of these sessions in the Omani Colleges is different. The microteaching sessions are applied side by side with the school-based practicum and in some cases, the school-based practicum starts before microteaching sessions.

Although the Ministry of Higher Education (1998b) defines 10-15 trainees/ microteaching group, the results indicate that there were larger groups in the microteaching sessions: (20-

30 student teachers in each and sometimes up to 40). This made microteaching difficult and ineffective, thus, student teachers become disinterested and unenthusiastic. The purpose of a microteaching lesson is to practice specific teaching skills to help the student teachers reach an acceptable level of performance through a small audience usually peers (McIntyre, Byrd and Foxx, 1996). To reach this acceptable level of performance, the organisation of microteaching sessions at the Colleges of Education ought to be revised. It is suggested that more attention should be paid to offering all the facilities needed, such as equipped microteaching rooms to carry out the microteaching. It is also recommended that enough tutors are available to facilitate each session. These tutors should be familiar with learning and teaching of science i.e. teachers themselves.

#### *f) School-based practicum*

The Ministry of Higher Education (1996) emphasises that school-based training should ensure a minimum number of hours for students to practise teaching in a school as part of the practicum programme. However, as reported by this study, sometimes, a student teacher may go for a week during the block practicum without a lesson to teach, thus, its benefit is limited. This might be because of poor organisation and implementation. For example, sometimes, there were about 40 to 50 trainees in one school (5 to 6 groups of 8 student teachers each group). Some supervisors had very large groups in one school; e.g. 21 student teachers (i.e. a group from each year). Thus, availability of lessons and supervisors is a big problem. Brooker and Service (1999) say that there is a concern about the continuing availability of school sites and supervision for practicum. This causes a lot of pressure and problems for trainees, school teachers, principals, and supervisors, and thus, the practicum has a low value. In addition, the block practicum is two or three weeks in some courses. This affects the accomplishment of the other courses in the college (subject-matter courses, educational courses and practicum workshops). The remaining weeks are definitely not enough to accomplish these courses which should be taught in 15



weeks. Thus, the school-based practicum should be reorganised to overcome these weaknesses. To increase the number of classes offered to trainees and to minimise the number of student teachers in each group of the practicum, many respondents suggested that all colleges should be coeducational. Making the colleges coeducational overcomes many of the practicum problems. All male and female schools in the vicinity of a college can then be used to decrease the number of trainees in each school.

*g) The length of practicum*

This study has indicated that the major problem for the accumulation of student teachers in the training schools is the practicum starting in the second year and lasting for six semesters. The length of the practicum is three years. Second-, third- and fourth-year student teachers are having training in the same school and at the same time. This was deemed by student teachers, newly qualified teachers and educators to be too a long time, with a low value. Second-year student teachers may be too immature to teach in the preparatory and secondary schools. This negatively influences the effectiveness of the practicum. At this early stage, student teachers are usually not prepared enough theoretically and practically in the subject-matter and pedagogical courses. They are not much different from the secondary pupils in subject matter content knowledge and age. One year before starting the practicum does not seem to be enough to prepare them in the subject-matter knowledge. This might also negatively affect their attitudes towards teaching. Many researchers who have studied the length of teaching practice and its effectiveness believe that teaching practice components make little contribution to helping beginning teachers become better teachers (Davis, 1982; and Thompson, 1984). Andrew (1990) evaluated differences between graduates of 4- and 5- year teacher training programmes. The results showed that graduates from the 5-year programme were more confident at the conclusion of their preparation. They were more positive about the school



environment, school administrators and pupils. They viewed their programme more positively than those on the 4-year programme.

Timing of practicum varies, usually beginning and ending during the students' final year in their programme (Coble and Koballla Jr, 1996). In the US, the length of practicum is typically a full semester (Coble and Koballla Jr, Ibid.) but at the North Global University the practicum is a one year programme which is considered as a very important feature (Alshannag, 1998). In this programme, student teachers practice their own teaching for a year under the supervision of field instructors and co-operating teachers. Goffree and Oonk (1999) conclude, "*back to the classroom will have consequences for how student teachers are taught to teach*" (p.214). Alshannag (1998) states that having teacher education programmes with one full year of student teaching is a key feature that allows prospective teachers to test their own theories about teaching (p. 238). This would provide great support for student teachers as they learn to use more effective approaches to teaching. Rothenberg *et al* (1993) indicate that those student teachers with more experience are more confident after the practicum.

However, a lengthier programme of practicum is not always productive. McIntyre, Byrd and Foxx (1996) examined the literature of teaching practice and they found that increasing the length of teaching practice without analysis and reflection does not lead to professional growth. They suggest that teacher educators must begin to utilise methodologies that allow them to understand the complexity of teaching and to present this to teaching practice.

To overcome the weaknesses of the current practicum in the Omani Colleges which is caused by the lengthy school-based practicum, the length of school-based practicum should be shortened to last for a whole year or a year and a half (three semesters). Byrd and Foxx

(1996) conclude that a shorter teaching practice with well-integrated experiences is more likely to produce effective, thoughtful teachers for the twenty-first century than a lengthier programme whose major attribute is length (p. 176) as the case in the Omani Colleges. Starting the practicum at the fourth year or the third year (second semester) is a useful way to overcome many of the problems of the current programme, and student teachers will be prepared in the subject-matter content and pedagogical aspects before teaching in the preparatory and secondary schools. The first semester is for observing actual lessons and for the serial practicum in preparatory schools, the second is for the serial practicum in secondary schools, and specifying the final semester for the block practicum as the results suggest that more focus on the block practicum is needed.

#### *h) Observation*

The effectiveness of the “Observation Teaching Period” was one of the lowest-rated aspects. This could be explained by the fact that this aspect is not addressed in the practicum programme and is omitted from the College document (Ministry of Higher Education, 1998b). Thus, it is not surprising that this aspect was rated ineffective. According to Coble and Koballa Jr (1996), observations are important opportunities for student teachers to observe actual teaching and to interact with their colleagues individually or in small groups and with their supervisors. This aspect helps them to understand the teaching and learning context. Thus, the Omani student teachers should have opportunities to observe lessons demonstrating what they have learned in subject-matter and pedagogical courses before starting real teaching in the schools. To increase the benefit from the observations, this study has suggested that student teachers should be given the chance to observe more actual lessons. Pre-meetings and post-meetings should be conducted with educators and co-operating teachers to discuss how the trainees maximise the benefit from this aspect.



### *i) Supervision*

In this study, the role of the supervisors of practicum (educators and co-ordinating teachers) was deemed to be important. These supervisors play an important role in helping and guiding student teachers to be successful in their teaching. If the supervisor is competent, enthusiastic, and sensitive to the needs of student teachers, either in the college-based practicum or in the school-based practicum, student teachers would definitely benefit and the practicum would be very useful and effective. Many studies have mentioned the important role of mentors and supervisors in training student teachers (Calderhead & Shorrock, 1997; Jones, 2000; McIntyre, Byrd and Foxx, 1996 and Parkinson, 1994). For instance, Jones (2000) indicates that all trainees perceived their mentor to be an important and supportive person in their professional development who provided “*a shoulder to cry on*” when required (p.71). Thus, the role of co-operating teachers and supervisors in the practicum is essential to the development of student teachers. However, in this study, the role of the supervisors who were from the Colleges and co-operating teachers were criticised. Factors affecting their impact are discussed below.

#### *ia): Educators*

In this study, the role of supervisors from the Colleges was criticised by many respondents. This is because some of them are not from the Department of Educational Studies but are from the Science Department or other departments who have little knowledge or experience of school education. This of course, as indicated by qualitative data, affects the credibility of evaluation. Specialists in science may evaluate student teachers from only the point of view of subject matter content and they do not pay any attention to the pedagogical performance. The results of this study have also confirmed that student science teachers feel they need someone to help them not only with the scientific content but also in the ways of effective teaching, assessment, and management of the learning



environment. Thus, the supervisors should be from the Curriculum Unit (science education) and they need to be aware of their role.

### *ib) Co-operative teachers*

Although this study has indicated that the role of co-operating teachers was one of the most important factors in the school-based practicum, the **lowest-rated** item of effectiveness of practicum aspects was the **role** of co-operating teacher. The student teachers and educators rated the college supervisors' feedback higher than the role of co-operating teacher. The participation of the co-operating teachers in training student teachers was very low. This could be interpreted to mean that the co-operating teachers just have a very minor part in the practicum component. They just provide lessons to student teachers and sometimes observe them but do not give any formal assessment. The assessment of student teachers' work is left entirely (100%) to the college supervisors. This means that the college supervisors have solely involvement in the practicum process; i.e. they teach such courses as subject-matter courses, and pedagogical courses. They are also entirely involved in the all aspects of the college-based and school-based practicum. Giving no defined responsibility to the co-operating teachers has a negative impact on the practicum. Sometimes, co-operating teachers resist providing student teachers with new lessons to practise during the practicum. This may have also affected the student teachers' low ratings of the co-operating teachers.

To maximise the role of the co-operating teachers in Oman, this study strongly recommends that co-operating teachers should be fully involved in the school-based practicum. They should participate in training and evaluating student teachers because of their experience in the subject matter and teaching and they can see student teachers day to day, unlike the college educators who see the students in a few visits only. As learning to teach is a stressful experience for many student teachers, there is frequently a need for

support and encouragement for them to face new experiences, consider alternative practices, and analyse their own performance if they are to improve upon it (Calderhead and Shorrock, 1997). Mentors and educators often have to judge an appropriate balance of support and challenge, knowing when encouragement or consolation is needed and when challenge is constructive (Ibid. p. 197).

Co-operating teachers or mentors should play an important role in preparing Omani student teachers. Jones (2000) says, mentor's roles are not clearly defined in an official job description. However, the Omani Colleges of Education could follow a school-based model following the U.K. experience (e.g. University of Warwick, 1998). The colleges could also benefit from ideas previously discussed in the literature concerning the mentor's role (Calderhead and Shorrock, 1997 and Fish, 1995). For instance, Calderhead and Shorrock, (1997) suggest six different processes of mentoring. Those are: influencing by example, influencing by coaching, influencing through practice-focused discussion, influencing through structuring the context, influencing through emotional support, and influencing through devised learning experiences. Thus, the mentor can be the main source of information about student teachers' teaching, the main source of advice and feedback about their own practice, and the main confidant and counsellor when things go wrong.

If the Omani Colleges are to involve co-operating teachers in the school-based practicum, they should recognise that these co-operating teachers should have the necessary skills. As Parkinson (1994) concludes that good mentors should have needed skills such as ability to: listen to and understand the needs of trainees; be sensitive to their efforts; provide necessary support, help and advice to them; and so on. Calderhead and Shorrock (1997) also state, in order to carry out the mentors' work effectively, teachers should have the required skills: developing a language to discuss teaching; being competent teacher; able to demonstrate a variety of practices; have a willingness to appraise their own practice;



counselling skills; target setting skills; understanding professional development; and be good at relationship building and collegiality. Being more cooperative in their practice will develop more potential learning experience for themselves, their student teachers, and their colleagues. As mentoring will be new work for the co-operating teachers in Oman, to maximise their role, Koehler (1988) reports that they should be given training in the analysis of teaching and supervision. Al Salmi (1996) argues that the lack of training of co-operating teachers may create difficulties in understanding their role in supervising student teachers and communicating with the university supervisor.

#### *j) Assessment form*

In this study, student teachers were concerned about the assessment of the school-based practicum. Jones (2000) indicates that such concern among trainees is caused by the fact that there are no formal, clearly defined assessment criteria available for reference or guidance. Thus, student teachers consider that the assessment of their teaching competence is not always objective, but may be influenced by the bias of individual tutors. At the Omani Colleges of Education, although there is a list of criteria for assessment of the school-based practicum (Ministry of Higher Education, 2000), the results of this study have indicated that the assessment criteria were interpreted differently from one educator to another for the same student teacher. This means that the final score of a student teacher's teaching competence is dependent on the individual tutor, e.g. their general knowledge and expertise about the student teacher. This element of subjectivity and bias, according to Jones (2000), affects the credibility of evaluation. Calderhead and Shorrock (1997) and Turney cited in Taib (1997) argue that honest and careful evaluation is important for the quality of teacher training. The implication from this study is that the College supervisors need to apply a careful evaluation and objective assessment where the criteria are strictly applied.



In addition, examination of the assessment form of the practicum (Ministry of Higher Education, 2000) indicates that it covers 20 statements for any lesson in any subject. It contains most of the predicted components of lessons: preparation plan, implementation, and evaluation. There are no specific items from the reformed system, which could be used as criteria for evaluating the student science teachers' ability to use one of the recommended science teaching methods such as a problem-solving approach and other science learning activities. Thus, according to Bekalo and Welford (1999), the practicum supervisors are not expected to judge this ability in their student science teachers. Student teachers are unlikely to have included the developed teaching methods if they do not have adequately high status to be part of an evaluation of their practicum competencies. Thus, the Colleges of Education should redesign this form to include specifically the necessary science teaching methods, if educators and student teachers know that it forms part of the assessment that it must be addressed.

#### *k) Practicum office*

As the planning, organisation and management of the practicum is time consuming, it is not efficient to be left to the educators, who already have their own work. This study recommends that an independent office with its own staff and management for the practicum should be established to carry out the planning and organisation of the various aspects of the practicum. The Colleges of Education might benefit from the experience of some teacher education institutions, e.g. the University of Warwick. At this University, a partnership office provides the interface between the Institute of Education and Partner and Associate Schools. It plays many important roles. Responsibilities include: communication across the Partnership, arranging school placements, making transport arrangements, providing help and guidance to schools and trainees during school placements, handling any problems which arise with regard to placements and travel, keeping attendance records

during school placements, co-ordinating the work of university link tutors, co-ordinating the provision of mentor training, and so on (The Partnership Office, 2001/2, p. 13).

### *1) Others*

The results of this study suggest that student teachers should not only teach lessons during the school-based practicum but also participate in other actions such as the examination work and school activities. For example, in England (Calderhead and Shorrock, 1997), student teachers in practicum are expected to carry out a series of structured tasks which might involve observation, assessment of pupils, or the teaching of particular lessons. Moreover, they are expected to take on all the activities that a teacher in school would do.

One concern highlighted by this study is that the Physics/Mathematics student teachers were not trained to teach mathematics during the school-based practicum. As they are expected to teach both science and mathematics after graduating from the Colleges, it is important that they should be also trained and assessed to teach mathematics during the school-based practicum.

A recommendation from this study is to design a file for each student teacher for the school-based practicum from the beginning until its end. This is seen as providing an accurate record of activities of the practicum. Also the supervisors in the Omani Colleges change from one semester to another and in many courses from serial practicum to block practicum in the same semester, this file will enable them to follow up the student teachers' progress during the whole period of the training.

Some student teachers indicated that they were not made to feel welcome by a school. Sometimes, they were treated as "*strangers*" by the schools' principals. This is confirmed by the fact that some principals were not interested in the practicum programme and they



did not agree to provide the trainees with enough lessons. Student teachers were not even given a place for sitting during breaks. This negative atmosphere would undoubtedly affect the effectiveness of the school-based work where full co-operation is needed to accomplish the practicum (Robinson, 1999). In addition, this also could affect student teachers' attitudes towards schools in general and their training in particular. Schools' principals need to be informed about the tremendous benefits that student teachers can bring to the schools. Hopefully this could change their attitudes towards student teachers and thus the schools should offer all facilities needed. It is important for schools to recognise their pivotal role in training the next generation of teachers.

Newly qualified teachers who graduated from the Omani Colleges of Education interviewed in this study indicated that they feel that they are better prepared than the Sultan Qaboos University (SQU) graduates, especially in teaching performance. This might be explained by the fact that the graduates from the Colleges had a longer length of practicum than the SQU graduates. The practicum at SQU only starts in the final semester (Al Salmi, 1996) whereas at the Colleges it starts in the second year (Ministry of Higher Education, 1998b). As this research did not provide enough data about this issue, more investigation is needed to find out the differences between the two practicum systems.

### *m) Conclusion*

Based on what is reported above, there is an immediate need to design a framework for the practicum that meets the demands of the new reformed general education and overcomes the weaknesses of the current practicum. This framework includes the planning, organisation, implementation, supervision, evaluation, and follow up of the practicum.

Finally, it is believed that if such a well-planned framework has been outlined, and the necessary facilities are provided, all practicum aspects would be enhanced.



### 6:2:2:3 Subject-Matter Courses

Although analysis of subject-matter courses was not an objective of this research, interesting issues emerged from the qualitative data and these need to be addressed. The results of this study have indicated that the percentage of specialisation courses is less than actually stated in the College documents, i.e. less than 55%. This is because there are some courses, which are counted with the specialisation courses, but they are not subject-matter courses. Examination of the College documents indicates that these courses are three named support courses for specialisation. These are: the Research Foundation and Statistics Course (3-credit hours/2.27%), the English Language for Specialisation Courses (3-credit hours/2.27%) and Introduction in Computing Course (3-credit hours/2.27%). Table (6:1) shows the actual credit hours of the components of the College programmes and their percentages.

**Table 6-1 The actual credit hours of the components of the College programmes and their percentages**

132 credit hours (100%)				
Specialisation courses = 73 credit hours (55%)		Professional and cultural courses = 33 credit hours (25%)		Practicum courses = 26 credit hours (20%)
Subject-matter courses = 64 credit hours (48.48%)	Support courses for specialisation=9 credit hours (6.8%)	Professional courses =27 credit hours (20.45%)	Cultural courses = 6 credit hours (4.55%)	Practicum courses = 26 hours (20%)

It is clear, then, that the percentage of the subject matter courses is less than 55%. It is only 48.48%. In addition, these courses are divided into two disciplines: major and minor. Furthermore, other weaknesses in the subject-matter courses were identified: they are superficial, they are not linked with the school-curriculum, the delivery of these courses is not effective and there is a repetition of some aspects. Hewson *et al* (1999) confirm that the lack of coherency and depth of what teachers know from course content leads to inadequate preparation of student teachers. Furthermore, as this study indicated, most student teachers come directly from the secondary schools with some weaknesses in their

scientific knowledge. These weaknesses contribute to inadequacies in training at the Omani Colleges of Education.

There is evidence that the educational courses and workshops at the Omani Colleges of Education are emphasised at the expense of the subject-matter courses. The science teacher education programme may be improved by shifting the balance between the components of the programme to place more emphasis on subject-matter courses. This is supported by other studies, e.g. Calderhead and Shorrock (1997) say that an increase in the level of subject study for intending teachers is a potential way of improving teacher education. Feiman-Nemser (1990) indicates that many teacher education reforms call for limiting the number of credit hours in education. The results of Grossman and Richert's (1988) study found that teachers felt a need to understand their subject matter more deeply. Goodlad (cited in Fullan, 1991) indicates that teacher education programmes must provide student teachers with the required subject-matter knowledge needed in schools.

Other studies also underline the importance of the subject-matter courses for all the teaching processes (Ball & McDiarmid, 1990; Dwyer, 1993; Grossman, 1989; and Shulman, 1986). Dwyer (1993), for example, says that teachers must understand their subject matter well enough to determine learning goals, to design or select appropriate activities and materials, to sequence instructions to help pupils to meet short-and long-term curricular goals and to design evaluation strategies. Hashweh (1987) reported that good subject knowledge has a positive effect in the teaching of biology and physics. Ball and McDiarmid (1990) assert that there is empirical evidence to support the belief that subject knowledge significantly and positively affects teaching. NCSESA (cited in Coble & Koballa, Jr, 1996) states that sufficient depth for secondary teachers is required to guide inquiries based on pupils' questions where breadth is required at the elementary level.



On the other hand, some educators believe that increasing the number of subject-matter courses should not come at the expense of pedagogical knowledge (Diegmueller, 1991, cited in Al salmi, 1996). Others believe that methodology courses are required at the expense of those that address subject-matter courses (Ferguson & Womack, 1993). Still others believe that both the pedagogical courses and subject-matter courses are important for good teaching (Cochran, *et al.*, 1993). Druva and Anderson (1983) also conclude that both science courses and educational courses are significantly and positively associated with successful teaching.

On balance, there is a good case for modifying the relationship between the subject-matter courses and educational courses on the science teacher education programmes in the Omani Colleges. In this study, student teachers suggested increasing subject-matter content to 65.9% and the educators suggested increasing it to 64.3%. Thus, it might be increased to 65%. This is in line with Ziton (1994) who believes that the percentage of subject-matter component should fall between 60% and 70%.

There is a clear indication that the new experientially-based science curriculum in reformed schools in Oman addresses the integration of science and the integration of science with other subjects. In addition, the reform also addresses aspects of science, technology and society in its science curriculum (Ministry of Education, 2001). The results of this study suggest that these aspects should be integrated within the college courses. Examination of these courses indicated that there is already a course called “ Integrated Sciences”. The course’s units are delivered by three tutors from the Science Department: the first teaches Biology, the second delivers Chemistry and the third teaches Physics. The way the course is delivered suggests that, despite its title, the integration of science is omitted because each tutor will teach the section related to his/her subject separately from the others. In addition, tutors who are from the Science Department in the Omani Colleges



are limited in knowledge about education and integrated science because they are pure scientists, i.e. not educationalists. Thus, the nature of this course should be restructured to include actual integrated science concepts and must be taught by educators from the Department of Educational Studies who know how to integrate science work.

Aspects of science, technology and society, are addressed theoretically in the Science Teaching Methods Course but they represent less than 2.67% from the whole course (Ministry of Higher Education, 1998a). The effectiveness of these aspects needs more investigation, as it was not determined by this research.

In conclusion, for the programmes of the Omani Colleges of Education to function effectively in preparing teachers, all the training components (subject-matter; pedagogical and practicum courses) should be connected, related and integrated together. As Coble and Koballa, Jr (1996) indicate, an effective programme is *the result when these parts (programme's components) are well-coordinated and incorporate cutting-edge thinking and practice* (p.475).

### **6:2:3 The Third-Level Section (Student Teachers' Prior Experience)**

Student teachers usually spend between 12 and 13 years in schools prior to entering college. During this period, they study many subjects including science. Therefore, when they begin their university courses, they already have certain knowledge about science, and knowledge about how they were taught and assessed. This might affect the understanding of their pre-service courses. As Mellado (1998) argues that pre-college education has a significant influence on teachers' subject matter understandings and their views on how science should be taught. Thus, the Omani Colleges of Education should consider the prior knowledge and experiences of student teachers in planning and implementing the training

courses. As Manouchehri (1997) argues that teacher education programmes must consider student teachers' prior beliefs and experience about subject and pedagogy that they bring to the pre-service programme. They must challenge students' beliefs about the adequacy of their knowledge base for teaching and help them to make implicit beliefs about teaching, learning, subject matter and learning to teach explicitly. More information is needed to find out the effects of student teachers' prior experience on the acquisition of their competencies, as this is not provided in this research.

### 6:3 Student Teachers' Competencies

Student teachers in this study had positive views towards using different experiential learning methods and assessment tools, but they could only use these methods to a limited extent, i.e. not effectively. In addition, while student science teachers demonstrated ability in a few competencies, they were deficient in the majority. In general, **only** 10.87% of their competencies were rated to be competent whereas approximately 86.96% of these competencies were rated to be average on exit from their training course. The items that were most deficient were: "*organising science learning through games*" (2.45), "*use ICT*" (2.54)", "*use problem solving methods*" (2.57), "*organising field work and visits*" (2.76). These competencies are extremely important for effective teaching of science in Oman because they feature highly in the reformed schools (Ministry of Education, 1995). The mean rating of all competencies was 3.05 and did not approach 3.5 (the level required by the Ministry of Education, Oman). This shortfall is consistent with the other findings of similar studies (e.g. Mifsud, 1996 & San, 1999). San (1999) in Japan found that the level of primary and secondary teachers' teaching skills provided by the university was very low. In Malta, Mifsud (1996) also found that student teachers in the final year of their training felt least prepared in the classroom-specific competencies, general professional competencies and subject-specific competencies.

The low level of perceived competencies among student science teachers leaving the Omani Colleges of Education and their lack of confidence in using the required teaching methods such as experiential learning methods and different assessment tools, could be a result of inadequate training and/or other factors. The qualitative data gathered in this research confirmed that student teachers had not been trained effectively to use these methods. Bantock, cited in Brandes and Ginnis (1986) associates, the incompetent use of



new teaching methods with insufficient training courses as the necessary skills and practice are seldom offered in their training. The **factors** constraining the student science teachers' acquisition of these competencies and abilities are **addressed in the three previous sections** (see sections: 6:2:1, 6:2:2 & 6:2:3).

### *ICT and Teacher Training*

The qualitative data from this study indicates that student teachers recognise that ICT is crucial for the teaching and learning of science. They repeatedly mentioned many benefits of using ICT in teaching and learning science. It is clear that ICT should be used in the teaching and learning of science because of its importance and effectiveness. It helps teachers to teach and deliver science effectively, facilitates pupils' self learning and increases pupils' understanding. In other studies, Blackmore *et al* (1992) show that most student teachers feel that it is important to use IT in their teaching and that their attitudes to IT are generally positive. Parkinson (1998) states that "*the value of computers as an educational tool is not in dispute*" (p. 69) for helping pupils to learn science. Barker and Beare (1999) conclude that for a more effective understanding in science, which allows students to draw conclusions and apply information, a hands-on approach using computer simulations with a reflective (constructive) approach is needed. Mills and Tillman (1994) indicate that the use of software offers learning activities appropriate for the development of higher-order thinking skills and problem solving. Being effective teachers in this era, student teachers must be capable of using Information and Communication Technology (ICT).

Despite the fact that this study and others indicate that there are many advantages of using ICT in teaching and learning, there was a strong indication that the Omani Colleges still do not effectively train student science teachers to use ICT in teaching science. The mean competence rating of "use information and communication technology" was very low

(2.54). Student teachers do not have the required skills to use it in their teaching. One interpretation of this is that the Colleges of Education do not put much emphasis on ICT training in their programmes. Training for using ICT in teaching science may be insufficient to meet the student teachers' needs. There are many factors that suggest this is the case. For example, the required facilities in the college were not good enough, e.g. insufficient computers (**this factor is addressed earlier, see 6:2:1:4**). In addition, only one course "Introduction to Computer" is part of the mandatory requirement and this course is not linked to how to use the computer in teaching and learning. Student teachers are not provided with examples or demonstrations on how to use computers in teaching and learning of science. In addition, although there are two computer labs in each of the Colleges, student teachers felt that the educators did not encourage them to use ICT and the educators themselves did not use ICT in their teaching of the college courses. This may not be surprising because there is no plan in the Ministry of Higher Education to train student teachers to use ICT. Pedersen and Yerrick (2000) point out that many teachers do not use computers for teaching and learning because they feel that they have inadequate knowledge, support, access or a combination thereof. They indicate that ICT should not be left for students to learn by themselves, i.e. educators should help them. Pedersen and Yerrick (2000) argue that if science teacher educators are not integrating technology in their lessons appropriately, it is unlikely that the current structure of teacher education programmes will make the necessary change.

Thus, there is a need for the Omani student teachers to be trained more extensively to use ICT. To develop student teachers' skills required to use ICT in teaching pupils, Parkinson (1998) argues that the teacher education programmes and schools should work together in the training process and this must be done through a coherent programmes. Brooks and Kopp (1990) argue that technology-based simulations included in the teacher education programmes are very effective. This provides prospective teachers with actual situations



that allow them to analyse teaching, suggest alternative teaching strategies and increase confidence in using different instructional materials. Pedersen and Yerrick (2000) report that “*teacher education programs bear a large part of the responsibility to rear teachers prepared to use technology, especially computers, in line with current science education visions*” (p. 145). They also recommend that serious consideration should be paid to the type of support for educators to effectively utilise and incorporate technology into their courses. Training to use ICT in teaching science could include many aspects. The Omani Colleges could consider strategies used in other countries such as England. For example, the training of English science teachers includes aspects related to: planning to use ICT to achieve teaching objectives; using ICT effectively in teaching; assessing and evaluating pupils’ progress in the subject having used ICT; personal, and professional use of ICT (TTA, 1999).

### ***Problem-Solving Approach***

Student teachers were found to feel positively about experiential learning methods in general and problem solving in particular as teaching approaches. They recognised that a problem-solving approach develops scientific thinking skills (process skills). Casey and Howson (1993), McCombs and Marzona (cited in Baumert, Evans & Geiser, 1998), Ministry of Higher Education (1999a), Pehkonen (1993) and Vesilind and Jones (1996) all indicate that the primary goal of a problem-based method is developing the pupils’ reasoning processes and these skills are one of the most important aspects of the reform of science teaching. Thus, if one accepts the importance of the process skills in teaching science, then teacher education programmes are obliged to train student science teachers to have these skills and understand their application to science education. Aspects of scientific process skills are addressed theoretically and practically within the Science Teaching Methods Course of the Omani Colleges (Ministry of Higher Education, 1998a).



However, information about the effectiveness of these aspects are not available in this study, thus, more investigation is needed in this area.

Omani student teachers also indicated an awareness that this method focuses on a pupil-centred learning approach. Cook (1992) says: at the core of the problem-solving approach, pupils are encouraged to participate in their own learning rather than continue to be the passive recipients of an activity dictated entirely by the teacher. They are encouraged to take responsibility for the learning process. In this approach, pupils often feel better about themselves. This approach can also help develop pupils' cognitive and affective aspects.

Omani student teachers also reported that, in the problem-solving approach, pupils participate in a real and active learning environment. Corte (2000) argues that the powerful learning environment created by the problem-solving method requires changes to the traditional role of teachers. Instead of being the main, if not the only source of information (as is often still the case in general educational practice), the teacher becomes a "*privileged*" member of the knowledge-building community. S/he creates an intellectually stimulating climate, models learning and problem-solving activities, asks thought-provoking questions, provides support to learners through coaching and guidance, and fosters students' responsibility for their own learning. Indeed, in this approach, pupils participate in a real, active and powerful learning environment but the teachers are the ones who create it.

This study indicates that the problem-solving approach needs very competent and well-prepared teachers. Pehkonen, (1993) says, the most important external influence in the problem-solving situation is the teacher, who usually gives the problem to the pupils. The teacher's skills, e.g. involving the pupils themselves in the activity, providing feedback and

arranging practice are potentially important in helping pupils to develop useful ways of solving problems (Stones, 1994: 172).

However, the results indicate that the Omani student teachers could not effectively use a problem-solving approach in their teaching of science. The main score for using this approach was low (2.57). This is supported by the mean of competencies needed for designing and applying a problem solving approach, which was also, regarded low (2.9). The qualitative data confirmed that student teachers could not effectively use this approach and they generally applied traditional teaching methods during the school-based practicum. These methods depended entirely on a teacher-centred approach not on a pupil-centred approach. Student teachers were only assessed on their abilities to memorise and repeat the scientific content. Although they were provided with a theoretical outline of the problem-solving approach in their pre-service teacher training programmes, they were not trained practically to use this method. Pehkonen (1993) indicates that for teachers to be able to teach using the problem solving approach requires them to be familiar with problem solving both in theory and practice.

Some student teachers blamed educators for the limited training in problem solving that they received. For example, they indicated that educators themselves might not know how to use this approach. The supervisors during the practicum also did not encourage student teachers to use this method. Casey and Howson (1993) argue that teacher educators must make fundamental changes in how to prepare teachers to teach using the problem-solving approach. Thus, the educators, in order to be able to help student teachers to use this method, should have not only the necessary theoretical knowledge about this approach but also have experience of its application.



The study indicated that the Science Teaching Methods Course does not address the problem solving approach in an effective way. Examination of the college documents (Ministry of Higher Education, 1998a) indicated that there is insufficient content on this topic. This aspect represents only about 1.67% of the whole course. Kahle and Boome (2000) believe that pre-service teacher training programmes should include sufficient curricular materials that address the problem solving approach. Corte (2000) states that creating a powerful learning environment for the problem-solving approach requires substantial investments in the training of teachers. The model of Casey and Howson (1993) could be considered as a component of the problem-solving approach in the Omani teacher education programmes. This model presents four key elements of a teacher education course designed to teach a problem-centred model to student teachers. These elements are: 1) *the conceptual foundation*, 2) *strategies for introducing the major components of the model*, 3) *strategies for helping the pre-service students make transformations in their reflective thinking, attitudes, and emotions*, and 4) *the organisational structure*. The description of these components is provided in the literature review (Chapter 3). Casey and Howson (1993) insist that teaching practice should also stress the problem-solving approach in which student teachers make a permanent connection between the problem-centred strategies learned on the course and their ultimate practice of teaching. There is evidence that including effective aspects of problem solving in the teacher education programmes is beneficial. For example, Peterson and Treagust (1998) conclude that pre-service programmes help the student teachers to develop both their knowledge base for science teaching and their ability to make reasoned judgements about their teaching when they are provided with problem-based learning situations in their training programme.

The literature review indicates that knowledge of the nature of science helps provide a secure basis for the planning and delivering of the science curriculum (Driver, Leach, Millar & Scott, 1999; Leach, Driver, Millar & Scott, 1997 and Ziton, 1994). Science



teachers would find it help to recognise the nature of science because their decisions about how and what to teach are affected by their understanding of this aspect (Brickhouse, 1990; Hodson, 1988 and Palmquist and Finley, 1997). Thus, pre-service science teacher education programmes are obliged to develop new student teachers who understand contemporary views of the nature of science and their applications to teaching (Palmquist and Finley, 1997).

In the Omani Colleges, aspects of the programme that deal with the nature of science are addressed within the Science Teaching Methods Course (Ministry of Higher Education, 1998a). However, these aspects are only taught theoretically. So, they need to be made more practically active. Akerson *et al*, (2000) state that an explicit, reflective activity-based approach to the nature of science and its interactions within the context of science methods courses seems to be promising in enhancing pre-service teachers' views about the working of scientific enterprise. The Omani Colleges could consider the experience of England and Wales about what trainees should know and understand about the nature of science (TTA, 1998).

Finally, due to the importance and effect of the teacher training courses in enhancing teachers' views of the nature of science (Akerson, Abd-El-Khalick & Lederman, 2000; Gustafson & Rowell, 1995; and Palmquist & Finley, 1997), studies should be conducted to identify the effectiveness of the Omani pre-service science teachers courses, especially the Science Teaching Methods Course, in improving the student teachers' conceptions of the nature of science. Questionnaires and semi-structured interviews might be utilised.

### *Summary*

The Omani Colleges of Education still do not effectively train student science teachers to use the required teaching methods such as experiential learning methods, different

assessment tools, ICT, and the use of a problem-solving approach. Thus, it is unlikely they will teach effectively in the reformed schools (the Basic Education: Stage Two) and secondary education. Brandes and Ginnis (1986) assert that teaching methods used by an incompetent teacher would be boring and unproductive. The acquisition of skills and competencies is a fundamental factor for effective teaching and for fostering pupils' learning (Avery and Williams, 1994; Gordon, 1987, cited in Al Salmi, 1996; Brookler & Service, 1999; Calderhead & Shorrock, 1997; Creemers, 1997; Kyriacou, 1995; and San, 1999).

The Omani Colleges of Education should recognise that student teachers need to be trained effectively to use these required teaching and assessment methods and be provided with conceptions related to ICT and experiential learning methods, such as the problem solving approach, and opportunities to practice these approaches. This needs to happen inside the training institutions and in the schools during the teaching practice. Effective teachers are expected to possess these competencies on exit from a teacher training programme and currently it appears that they do not. AlBelushi and AlKitani (1997) confirm, there is no doubt that teacher education programmes are not successful if teachers are not fully ready for the teaching in schools. Brookler and Service (1999), Goodlad (cited in Fullan, 1991), and Manouchehri (1997) all confirm that teacher education programmes should play an integral role in familiarising student teachers with the necessary intellectual tools and competencies to respond to the demands of the contemporary school teaching context with a certain level of confidence.

Thus, the Omani Colleges might wish to consider Calderhead and Shorrock's (1997) argument in this context: they confirm that the teacher education programmes have to equip student teachers with the required knowledge and skills to function in the schools in which they will teach. Furthermore, at the same time, they should prepare them as potential

innovators who may **improve** the quality of existing practice, dealing with the many uncertainties that accompany the innovation process. Hence, if Oman wants the new trends of teaching and learning to be implemented, appropriate attention should be given to the preparation of effective teachers, by changing and developing the **input, processes and context**, of the Colleges in order to develop the college **outcomes**.

Finally, if pre-service teacher programmes do not prepare effective teachers, it is very important that this be remedied in in-service training programmes. Thus, the next section deals with professional development of future teachers.



## 6:4 In-Service Teacher Training

Although the main document of the Omani Colleges addresses the competencies of continuing professional development (Ministry of Higher Education, 1996) as a part of competencies that student teachers should study, the results of this study have indicated that the College curriculum does not include aspects of professional development and continuous learning. This is seen as a weakness because pre-service programmes should address such aspects to help prospective teachers to develop professionally throughout their work. As Kahle and Boome (2000) argue, it is important for pre-service education to set the expectation for continued learning. Hewson *et al* (1999) also believe that preparing future teachers to become competent professionals is central to any reform efforts in the world. Thus, it is important to build a strong relationship between the components of pre-service teacher programmes and in-service teacher education. This, according to Hewson *et al* (1999), helps teachers to move smoothly from pre-service teacher education through the induction years into on-going professional development in their careers. This is also supported by Kahle and Boome (2000) who highlight the need to connect pre-service science teacher education more closely with in-service professional development. Omani pre-service teacher programmes need to address aspects of continuing professional development to prepare future teachers who will enter the profession, recognising that they will continue to learn throughout their work, as well as understanding and having competence to practice in the ways of teaching called for in a current reform movement.

There is a strong indication presented in this thesis that the Omani Colleges did not prepare student science teachers to have the necessary competencies required by the reformed system. Thus, in-service courses should be organised to remedy the insufficiency of pre-service training programmes. Those courses are to train teachers to use the required

teaching competencies that they had not been trained to use such as ICT, experiential learning methods, the problem solving approach, and necessary skills of assessment and evaluation. Abdal-Haqq (1996) states that when teachers received their training in a way that prevented them from acquisition of the necessary skills to function effectively in learner-centred schools, an effective professional development should be implemented.

Thus, the Omani Ministry of Education through, the Department of Training and Professional Development (DTPD), needs to pay necessary attention for in-service training programmes. Kyriacou (1995) argues that the development and extension of teachers' skills is not simply their personal responsibility. Rather, it is also, in part, the responsibility of those within the schools and agencies outside the schools to ensure that such development is facilitated for teachers' professional development (p. 15). The Ministry of Education should facilitate an effective climate that helps teachers to develop their teaching skills through induction programmes. The induction programmes generally include components such as graduate courses, workshops or seminars, supervision, and support in the form of handbooks and newsletters (Plummer and Barrow, 1998, p. 295). The literature of in-service training confirms the effectiveness of workshops as in-service programmes in developing teachers' knowledge and competencies of the new teaching methods such as problem-solving, co-operative learning, and hands-on activities (Luft, 1999 & Wise, Spiegel, and Bruning, 1999). The Ministry of Education might consider these approaches to train science teachers and to equip them with the necessary knowledge and required skills.



## **6:5 Recommendations**

In assessing the overall results, it is clear that the science teacher education programmes at the Omani Colleges of Education still do not effectively train student science teachers who are able to cope with teaching in the reformed education schools (the Basic Education: Stage Two). This study has indicated that while student science teachers demonstrated ability in some competencies, they were deficient in the majority. Thus, there is an immediate need to develop and improve the structure and the system of these Colleges in order to promote teachers' professionalism in teaching science as recommended by the Ministry of Education (the Basic Education, Stage Two). Based on the findings of this study, it is suggested that when engaging in the forward-looking task of developing and improving teacher education programmes, the curriculum planners at the Colleges of Education may need to consider the recommendations of this study as a first step in improving the present science teacher preparation programme. Many effective models should be designed such as: Problem-Solving Approach Model, Pedagogical Content Knowledge Model, Practicum Framework, and Mentor Role Framework. The planners and designers should have knowledge of school requirements. The following are some recommendations for the Ministry of Higher Education:

### **6:5:1 For the Development of the Pedagogical Courses**

This section deals with recommendations that can help to develop the pedagogical courses in order to make them more effective and advantageous to student teachers (Research Question: 4). These recommendations are also related to the Research Questions 1, 2 and 3.

The recommendations are:

1. The Colleges of Education should restructure these courses and aspects to be in accordance with the requirements of the Ministry of Education. Policy makers and curriculum planners need to be certain that the philosophy, objectives and characteristics of the reform, integral components, teaching and learning methods,



curriculum and assessment and evaluation tools of the science education reform, are made explicit and objectives in pre-service science teacher education.

2. A co-operative committee between the Colleges of Education and the Ministry of Education should be formed to encourage collaborative efforts in planning and designing the components of science teacher education programmes. Accommodations should be made so that the content of the science curriculum of the schools is reflected in the college courses.
3. Teacher preparation programmes should not just focus on preparation in theory, but should also deal with a more practical approach to the nature of classroom teaching. In other words, the pedagogical courses should increase the time and effort spent in translating teaching theory into actual practice.
4. To reduce the theoretical emphasis and to increase the effectiveness of the pedagogical courses, it is important to eliminate any redundancy in the theoretical aspects. This will increase time for applying more practical work.
5. Integrating theory and practice by using simulation experience, group tasks and written assignments.
6. Replacing the repeated aspects of these courses with new trends of pedagogy and subject-matter courses.
7. The College of Education should provide appropriate resources. This includes: supported and sufficient references, enough computers, films and programs, required equipment for the scientific and psychology labs, and sufficient facilities provided for activities. In addition, the Colleges should provide references that are related to the requirements of the reformed general education and scientific journals to the college's library.
8. Increasing the number of educators in the colleges.
9. The Colleges of Education would be required to review and develop their staff competencies to effectively implement the relevant new approaches and techniques in delivering the college programmes. There is an immediate need for special programmes to train the College educators. Efforts should be directed toward promoting an awareness about the reformed general education because such effective courses require competent educators to deliver them.
10. Handouts, handbooks, booklets, or other sorts of written materials with complete descriptions and a clear picture of the philosophy of the reformed general education should be distributed to the student teachers and college staff. This will be done co-operatively with the Ministry of Education.
11. The teaching methods, and assessment and evaluation tools used in the Colleges of Education in all the three components: the subject-matter courses, the professional courses and the practicum, would require modification and improvement. Student teachers should be taught by using a range of developed teaching and assessment methods that are used in the reformed schools. Varying these methods is a desirable goal to develop the delivering of the College programmes. This, of course, will help student teachers in their teaching.



12. More attention should be paid to the Science Teaching Methods Course. This course should be designed as a model or framework of pedagogical content knowledge. This could be done based on the models addressed in the literature review (Cochran, DeRuter, and King, 1993; Kelly, 2000 and Manouchehri, 1997). Communicative and collaborative committees formed from science specialists, pedagogical experts, and experienced teachers should be co-operative to design such a course that better combines scientific content and pedagogical aspects.
13. The Science Teaching Methods Course should be allotted six-credit hours (in two semesters) to be taught. In addition, providing a sufficient time to accomplish the Development Psychology and Psychological Health Course, and the Research Foundation and Statistics Course is also suggested.
14. The teacher education programmes should consider the prior knowledge and experiences of student teachers in the planning and implementing the training courses.
15. Studying the possibility of adding new courses and aspects to the College programme such as, Introduction in Education Course, Information Technology Course, sociological psychology aspects, psychological guidance, epistemological psychology aspects, classroom management, administration and computer, educational foundation, education, learning's difficulties and society and professional development and continuous learning.
16. Up-dating the content of the elective courses and providing more than three elective courses in order to give student teachers the opportunity to choose.
17. Paying more attention to and updating the aspects of the Pedagogical Courses, especially Comparative Educational Systems Course, the Educational Technology Course, and the Education Foundation.
18. Reviewing the frameworks of the pedagogical courses from time to time.
19. Teacher education programmes should also actively involve current research going on in the field of programmes' evaluation in order to improve them.

### **6:5:2 For the Development of the Practicum Aspects**

There is an immediate need to design a framework for the practicum that meets the demands of the new reformed general education and overcomes the weaknesses of the current practicum. This framework includes the practicum aspects, the planning, management, implementation, supervision, evaluating, and following up the practicum. This framework could depend on the following recommendations: (Research Question 5). These recommendations are also related to questions 1, 2 and 3.)

1. As the Colleges of Education and schools are both working toward common goals; i.e. preparing prospective teachers, they should work hand in hand with the training of

student teachers to meet the requirements of the schools. The focus on the required competencies should and must begin in the Colleges of Education, and continue in the schools during the school-based practicum. It is also important that the college staff have a thorough working knowledge, based on the requirements of the general developed education.

2. It is important to restructure, reorganise, integrate and connect the practicum components.
3. It is recommended to pay more attention to building a strong relationship between the Colleges and the schools. It is suggested holding regular meetings and seminars to increase the awareness of student teachers, college staff, schools' principals and co-operating teachers of the importance of the practicum. This would enhance the dialogue between the Colleges and schools, strength the relationship between them, and suggest solutions for a lot of problems that might occur during the school-based practicum, then, the effectiveness of the practicum would increase.
4. The Administration Duty Visits' aspect should be shortened and included in the serial or block practicum.
5. The Curriculum Content Mastering Competency Workshops and other new educational aspects should replace the repetition of the workshops. Those workshops should be taught by tutors from the Department of Educational Studies. Designing workshops that combine subject matter and educational aspects should be also addressed to eliminate the repetitions and to maximise the effectiveness of the practicum. It is also suggested that workshops should be taught before or during the school-based practicum not after it.
6. More attention should be paid to offer all the facilities needed such as equipped microteaching rooms to carry out the microteaching sessions.
7. Offering sufficient tutors to teach microteaching sessions who should be familiar with learning and teaching of science; i.e. teachers themselves.
8. Student teachers should be given the chance to observe enough lessons. Pre-meetings and post-meetings should be conducted with educators and co-operating teachers to discuss how the trainees could maximise the benefit from this aspect.
9. The lessons given to the student teachers should be increased to allow for greater opportunities to exercise and refine the skills required for teaching in a real situation. This will enable pre-service teachers to discover their mistakes and improve performance.
10. To increase the number of classes offered to trainees and to minimise the number of student teachers in each group of the practicum, all the six colleges should be coeducational.
11. The supervisors of student science teachers should be from the Curriculum Unit (science education) and they should be aware of their role.
12. The college educators should apply a careful evaluation, and the assessment of student teachers' practicum should be objective.



13. An assessment form for the practicum should be redesigned to include specifically the necessary science teaching methods.
14. Co-operating teachers should be effectively involved in training and evaluating student teachers due to their important role in the development of student teachers, their experience in the subject matter and teaching, and their day to day contact with student.
15. A framework for the role of co-operating teachers should be developed based on the experience of other countries, e.g. the U.K. (guide for mentors of the University of Warwick). The colleges could also benefit from the previous literature review concerned with the mentor's role.
16. The Colleges of Education should hold an orientation meetings and sponsor workshops for co-operating teachers to familiarise them with methods of dealing with student teachers and to explain what the colleges expect of them during the school-based practicum.
17. The length of the school-based practicum should be shortened to last for a year or for a year and a half (three semesters). The **first** semester focuses on observation of actual lessons and on the serial practicum in the preparatory schools, the **second** is for serial practicum in the secondary schools, and specifying the **final** semester for the block practicum.
18. To solve many problems of planning, management, implementation and evaluation of the practicum, an independent office with its staff and management for the practicum should be established.
19. Student teachers should not only teach lessons during the school-based practicum but also should participate in other actions such as the examination work and school' activities.
20. Student teachers who are in the Physics/Mathematics' specialisation should be also trained to teach mathematics during the school-based practicum.
21. Schools' principals should be aware of the importance of their cooperation with student teachers and they should play an active role in the training of the student teachers.
22. A file for each student teacher should be made to make the follow-up of progress during the practicum easier.
23. Offering a place for student teachers in the schools is important: a room for sitting during the breaks, meeting with supervisors and for discussions.

### **6:5:3 For Teaching Competencies**

As the Omani Colleges of Education do not prepare effectively student science teachers to have the required competencies to teach in the reformed schools (the Basic education; Stage Two), recommendations presented in (sections 6:5:1 and 6:5:2) are expected to

develop their competencies. In addition, the following are some recommendations that might help to improve student teachers' competencies: (Research Questions: 1, 2, and 3)

1. The Omani Colleges of Education should pay attention to equipping student teachers with the required competencies to run the reformed schools as effective teachers are expected to possess the required teaching skills on entering into a professional training programme.
2. Curriculum planners need to include more work in the competencies that received mean scores less than 3.5 in this study.
3. Recommendations found in the literature relevant to the acquisition of teaching competencies (e.g. Kyriacou, 1995) may be taken into consideration in order to improve the teacher programme investigated in this research.
4. There is an urgent need for student teachers to be trained more extensively to use ICT. Technology-based simulations included in the teacher education programmes are very effective approaches. ICT training in England (TTA, 1999), for example, could be considered to train student science teachers in the Omani Colleges of Education. It is also recommend that serious consideration should be paid to the type of support for educators to effectively utilise and incorporate technology into their courses.
5. It is crucial to train student teachers to acquire the necessary experimental skills both in the college courses and during the school-based practicum.
6. Student teachers should be trained to use the required experiential learning methods and be provided with conceptions related to these methods and opportunities to practice them, both inside the training institutions and in the schools during the teaching practice.
7. Specific attention should be paid to making fundamental changes in how student teachers are prepared to use the problem solving approach. This requires substantial investments in the training courses. Pre-service teacher training programmes should include curricular materials that address the problem solving approach theoretically and practically. The model of Casey and Howson (1993) could be considered as an element of the pedagogical components of teacher education programmes.
8. More attention should be paid to developing the delivery of aspects of the nature of science and scientific process skills. The Colleges should develop and activate the existing aspects. The Colleges could consider the experience of England and Wales about what trainees should know and understand about the nature of science (TTA, 1998). The Colleges also could consider what is addressed in the literature review about these aspects (e.g. Driver, Leach, Millar & Scott, 1999; Leach, Driver, Millar & Scott, 1997; and Palmquist & Finley, 1997 and Ziton, 1994).
9. Student teachers should be trained to use the necessary assessment and evaluation methods.

#### **6:5:4 Other Recommendations:**

1. It is strongly recommended increasing the credit hours in the area of subject-matter courses. It might be increased to 65%.



2. The nature of the Integrated Science Courses should be restructured to include actual integrated science aspects and must be taught by educators from the Department of Educational Studies who know how to integrate science aspects.
3. Activating the delivery of the existing aspects of science, technology and society.
4. Other recommendations for subject-matter courses: providing student teachers with the subject-matter content related to the reformed schools, studying specialisation courses deeply, paying more attention to the practical work of the specialisation courses, arranging scientific field trips for student teachers, and changing elective subject-matter courses to compulsory courses.
5. More attention should be paid to the quality of training by modifying the entry standards to the Omani Colleges of Education. Student teachers should also be assessed and interviewed before accepting them to start their training in the colleges. The assessment and interviews are meant to evaluate student teachers' attitudes towards the teaching job and to identify their interests and personalities.
6. The Colleges of Education should study the possibility of increasing the length of study to five years. The following is the suggested structure of the five-year programme: three years are for studying specialisation courses; one year is for studying professional courses; final year is for the practicum.
7. Teacher programmes in the developed countries such as the U.K. and the U.S. could be taken as a basis to develop the college programmes.
8. It is important to use English in teaching some college courses. In addition, it is also recommended to increase the credit hours of English. These courses might be formed to serve some the subject matter courses and education courses, and distributed in the four years of the study.
9. As the graduates from the Colleges of Education and SQU are recruited in the same schools, it is important that those institutions unify their teacher education programmes.
10. Paying more attention to the extra-curricular activities in the colleges.
11. The college courses should be linked with professional development of prospective teachers. It is important to set expectations to continued learning in these courses.

#### **6:5:5 Recommendations for the Ministry of Education:**

1. In-service programmes should be organised to remedy the dereliction of pre-service training programmes. Those courses are to train teachers to use the required teaching methods that they had not been trained to use such as, ICT, experiential learning methods, the problem solving approach, and assessment and evaluation skills. The Ministry could organise programmes such as graduate courses, workshops or seminars, supervision, and support in the form of handbooks and newsletters.
2. Provision of the necessary resources in schools should be taken care of in order for the new trends of teaching and learning to function successfully.



3. Science teachers should be actively involved in conducting research related to their field, which might help them to improve their abilities and further develop methods of teaching science.
4. The Ministry of Education should provide the Colleges of Education with the related materials of the general reformed system.

## 6:6 Implications and Research

Research in the field of teacher education in Oman needs to be given more attention. If teacher education is to maintain a continuous development in its training of student teachers, there is a need for the change and development to be based on evidence and tested understandings. In this regard, Calderhead and Shorrock (1997) confirm that research and evaluation should be part of the culture of teacher education institutions, and should be part of the dialogue amongst policy-makers, teacher educators and teachers. Indeed, research has an essential role to play in supporting the quality of teacher education and providing the basis for the professional development of teachers. Jong and Brinkman (1999) strongly believe that, to the extent that a gap between research and teacher education exists, it should be closed. By strengthening co-operation between research groups in teacher education and active teacher educators, it should be possible to set a “*research agenda*” which will identify research areas both important on the theoretical level for research and potentially beneficial for practising teacher educators (Jong & Brinkman, p.8).

This research has implications for the Colleges of Education in Oman and for research on teacher education in general. A combination of qualitative and quantitative approaches provides a very beneficial opportunity to identify the effectiveness of teacher education programmes. However, the analysis of the qualitative data is a complicated business and time consuming, so, some narrowing of focus becomes necessary. This study, as with most educational research, also raises many questions about practice which need further investigation. Thus, the researcher is aware of the need to collect additional types of data requiring different methods such as portfolio analysis, classroom observations, and journals. There is also a need for research to be conducted with the college staff, graduates, school principals, inspectors and policy-makers in both the Ministry of Education and the

Ministry of Higher Education. It is recommended that data might be gathered to identify other research aspects. For example, research is needed in the following areas:

1. A comparative study between the SQU teacher education programmes and the Colleges of Education' programmes;
2. Subject matter components are essential parts in any teacher education programme. However, the effectiveness of these courses was not investigated in this study. Thus, to report findings about these courses, new instruments and other interview schedules need to be developed and used;
3. Additional empirical research should be conducted to examine the other teacher education programmes at the Colleges of Education such as mathematics, social studies, Arabic, and Islamic teacher education programmes;
4. A study is needed to investigate the advantages and disadvantages of a **full-semester practicum** with the current programmes at the Colleges of Education;
5. There is a need for a further investigation to study the reasons for the insufficiency of resources at the Omani Colleges;
6. Due to the importance and effect of the teacher training courses in enhancing teachers' views of the nature of science, another research possibility would be to identify the effectiveness of pre-service science teachers courses, especially the Science Teaching Methods Course, in improving the student teachers' conceptions of the nature of science at the Omani Colleges of Education;
7. Due to the importance of the science process skills in science education, it is crucial to measure the student teachers' process skills at the Omani Colleges of Education;
8. A study is needed to investigate the effectiveness of the existing aspects of science, society and technology within science teacher programmes;
9. An investigation is needed to find out the effects of student teachers' prior experience on the acquisition of their competencies
10. Such studies are necessary to complement the findings of this study.



## 6:7 Conclusion

In conclusion, this review of the science teacher education programme in Oman has identified the challenges ahead for those who are involved in the development of teacher preparation programmes. This study has explored the effectiveness of the initial training programme at the Omani Colleges of Education in preparing student science teachers. The study tools of this research produced interesting and useful data about the student teachers' skills and the curriculum of the colleges and the manner in which it was implemented. It has not only shown a serious gap between the actual needs of science teachers (importance) and their preparation (effectiveness) by the colleges, but identified also the areas of weakness.

The student teachers and educators were chosen as respondents in this study because of their abilities to recall accurately specific elements of the college programmes and because they had first-hand experience of the implementation of the teacher training courses either inside the colleges or in the school-based practicum.

This research has used student teachers and teacher educators as sources of information, opinions and views. The results presented indicate that the student teachers and educators hold very similar views about teaching competency, the programme of science teacher training offered by the Colleges of Education and the education reform. This computability of data gives extra weight to its validity and is one of the goals of triangulation. It also highlights that student teachers can be an important source of data for the development of teacher education programmes (Gustafson & Rowell, 1995; Mifsud, 1996; Patrick & Smart, 1998 and Wilson & Cameron, 1996) and this has great implications for future research in this area.

The study tools were adapted to the specific context of the required skills of science teachers and the components of the Omani Colleges of Education. This limits the scope for generalisation of the results to other contexts. However, the findings in general do raise questions about the relationship between the training student teachers receive and the required teaching skills in the schools. In addition, this study also reveals big gaps in the relationship between the importance and effectiveness of the components of the programmes of the Colleges of Education. As in evaluative studies (Bullock and Scott, 1992; Galluzzo and Craig, 1990; Jong and Brinkman, 1999 and Worthen *et al.* cited in Mertens, 1998), this research also achieved some purposes of carrying out an evaluative study. It provided accountability (summative evaluation); understood the process more clearly; analysed some difficulties and problems in the science teacher programme; provided some strategies and recommendations for development; and produced knowledge. This knowledge is related to experiential learning methods, problem-solving methods, ICT, the importance and effectiveness of the pedagogical courses, and practicum aspects. This might contribute to the knowledge of science teacher education in general.

Finally, revisiting the framework of this study addressed in chapter one, it is seen that the research aims have been accomplished. In addition, the research questions have been answered. Recommendations for the Ministry of Higher Education for the development of the existing science teacher education programmes, for the Ministry of Education and for implications further research, have been made.



## References:

- Abdal-Haqq, I. (1996, October). Making Time for Teacher Professional Development, ERIC Digest. (ERIC Document Reproduction Service No. ED 400259).
- Abell, S. and Bryan, L. (1997). Reconceptualization the elementary science methods courses using a reflection orientation. Journal of Science Teacher Education, Vol. 8, pp. 153-166.
- Akerson, V.; Abd-El-Khalick, & Lederman, N. (2000). Influence of reflective explicit activity-based approach on elementary teachers' conceptions of nature of science, Journal of Research in Science Teaching, Vol. 37 (4), pp. 295-317.
- Al Barwani and Ibrahim (1997). An evaluation study of teacher education programme at Sultan Qaboos University: graduates' performance and perceptions. International Yearbook on Teacher Education, ICET, Vol. (1), Sultanate of Oman: Mazoon Printing Press.
- Al Belushi, S. & Al Kitani, S. (1997). The Sultanate of Oman and a new educational reform, International Yearbook on Teacher Education, ICET, Vol. (1), Sultanate of Oman: Mazoon Printing Press.
- Al Busaidi, H. (1999). The implementation of the new primary science curriculum in Oman-an initial evaluation, Unpublished Master Dissertation, University of Warwick: Great Britain.
- Al Busaidi, R, & Bashir, H. (1997). Development of the Colleges of Education for Teachers in the Sultanate of Oman. . International Yearbook on Teacher Education, Vol. (1), pp. 172-183. Sultanate of Oman: Mazoon Printing Press.
- Al Hammami, H. (1999). Education for 21<sup>st</sup> Century: General Education Reform in Sultanate of Oman: Motives, Nature and Strategies of Implementation, Unpublished doctoral dissertation, University of Birmingham, Birmingham: Great Britain.
- Al Hethli, A. M. (1995). The teaching skills of social studies teachers in the primary stage from the point of view of the supervisors, (In Arabic). Art College Journal, Vol. 9 (35), pp.145-173.
- Al Hinai, A. M. (1997). The Need of Redefine Teacher Education in Oman. Promoting Quality Teacher Education for an Interconnected World. International Yearbook on Teacher Education, Vol. (1), pp. 196-516, Sultanate of Oman: Mazoon Printing Press.
- Al Salmi, H. (1996). Graduates' Perceptions of the Secondary Social Studies Teacher Education Program at Sultan Qaboos University, Oman. Unpublished doctoral dissertation , University of Pittsburgh, U.S.A.
- Al Salmi, T. (1994). Teacher Education in Oman: Selection and Training of Primary School Teachers. Unpublished doctoral dissertation, University of Birmingham, Birmingham: Great Britain.



- Al Sowidi, K. & Al Kalili, K. (1997). The Curriculum, (in Arabic), Dubai: Dar Alklam.
- Al Zakwani, K. (1997). Education and development in Oman, International Yearbook on Teacher Education, Vol. (1), pp. 196-516, Sultanate of Oman: Mazoon Printing Press.
- Alkin, M. and Ellett, F. (1990). Development of evaluation models. In H. Walberg and G. Haertel (Eds.), The International Encyclopedia of Educational Evaluation. (pp. 15-21). Oxford: Pergamon.
- Alkindi (1997). A Survey of Science Teacher's Attitudes Towards their Participation in Curriculum Development in Omani Preparatory Schools. Unpublished Master Dissertation, University of Birmingham: Great Britain
- Alshannag, Q. M. (1998). Knowledge, Beliefs, & Performance of New High School Chemistry Teachers: A study of Teachers' Characteristics & Teacher preparation Program Influences. (Unpublished Doctoral Dissertation. Michigan State University: USA (Microfiche N. 9909253).
- Anderson, C. W. (2000). Challenges to science teacher education. Journal of Research in Science Teaching, Vol. 37(4), pp. 293-194.
- Andrew, M. (1990). Differences between graduates of 4-year and 4-year teacher preparation programs. Journal of Teacher Education, Vol. 41 (1), pp. 45-51.
- Ariza, R. & Gomez, S. (1992). The change of teachers' conceptions: a strategy for inservice science teachers' education. Teaching & Teacher Education, Vol. 8 (5/6), pp. 537-548.
- Ashburn, E. A. (1987). Three Crucial Issues Concerning the Preparation of Teachers for Our Classrooms: Definition, Development, and Determination of Competence. Office of Educational Research and Improvement (ED), Washington, DC, (ERIC Document Reproduction Service No. ED281912).
- Audah, A. & Malkawi, F. (1992) Scientific Research Basics in Education (2<sup>nd</sup> ed.), (in Arabic), Jordan, Irbid: Alkatani Library.
- Ball, D. & McDiarmid, G. W. (1990). The subject-matter preparation of teachers. In W. R. Houston (Ed.), Handbook of Research on Teacher Education: A Project of the Association of Teacher Education. (pp. 437-449). London: Macmillan.
- Barker, R. & Grayson, J. (1994). USC Metropolitan Teacher Education Program: A Follow-up of its Graduates. U. S. A.: California, (ERIC Document Reproduction Service No. ED385520).
- Barker, S. and Beare, R. (1999). Teaching population strategies: an evaluation of approaches, Journal of Biological Education, Vol. 33 (3), pp. 149-154.
- Barton, R. & Elliott, J. (1996). Designing a competency based framework for assessing student teachers: The UEA Approach. In D. Hustler & D. McIntyre (Eds.), Developing Competent Teachers: Approaches to Professional Competence in Teacher Education, London: David Fulton Publishers Ltd.
- Baumert, J., Evans, R. & Geiser, H. (1998). Technical problem solving among 10-year-old students as related to science achievement, out-of-school experience, domain-



specific control beliefs, and attribution patterns, Journal of Research in Science Teaching, Vol. 35 (9), pp. 987-1013.

- Bekalo, S. A. and Welford, A. G. (1999). Secondary pre-service teacher education in Ethiopia: its impact on teachers' competence and confidence to teach practical work in science, International Journal of Science Education, Vol. 21 (12), pp. 1293-1310.
- Bell, J. (1993). Doing Your Research Project: A Guide for First-time Researchers in Education and Social Science. Buckingham: Open University Press.
- Bennett, N. (1988). The effective primary school teacher: The search for a theory and pedagogy, Teaching and Teacher Education, Vol. 4 (1), pp. 19-30.
- Best, J. & Kahn, J. (1989). Research in Education (6<sup>th</sup> ed.). New Jersey: Prentice-Hall, Inc.
- Blackmore, M.; Stanley, N.; Coles, D.; Hodgkinson, K.; Taylor, C.; and Vaughan, G. (1992). A preliminary view of students' information technology experience across UK initial teacher training institutions, Journal Information Technology for Teacher Education, Vol. 1 (2), pp. 241-254.
- Blaxter, L. *et. al.* (1996). How to Research. Buckingham: Open University Press.
- Boone, W. J. & Gabel, D. L. (1998). Effectiveness of a model teacher preparation program for the elementary level. Journal of Science Teacher Education, Vol. 9 (1), pp. 63-84.
- Borg, W. R. & Gall, M. D. (1989). Educational Research: An Introduction. New York: Longman.
- Boulianne, R. & Weston, C. (1987). Discrepancy between preparation and practice in teacher education: An Ecuadorian study, Teaching & Teacher Education, Vol. 3 (2), pp. 99-107.
- Brandes, D. and Ginnis, P. (1986). A Guide to Student-Centred Learning, Oxford: Basil Blackwell Ltd.
- Brickhouse, N. (1990). Teachers' beliefs about the nature of science, and their relationship to classroom practice, Journal of Teacher Education, Vol. 41 (3), pp. 53-62.
- Brooker, R. & Service, M. (1999). Context for teacher education: an Austrian alternative. Journal of Education for Teaching, Vol. 25 (2), pp. 151-167.
- Brooks, D. & Kopp, T. W. (1990). Technology and teacher education. In W. R. Houston (Ed.), Handbook of Research on Teacher Education: A Project of the Association of Teacher Education. (pp. 498-513). London: Macmillan.
- Bullock, K. & Scott, B. (1992). Evaluating and innovation, Assessment and Evaluation in Higher Education, Vol. 17 (2), pp. 111-125.
- Calderhead, J. & Shorrock, S. (1997). Understanding Teacher Education: Case Studies in the Professional Development of Beginning Teachers. London: Falmer.
- Casey, M. & Howson, P. (1993). Educating preservice students based on a problem-centered approach to teaching. Journal of Teacher Education, 44 (5), pp. 361-369.

- Cepni, S. (1993). New Secondary Science Teachers' Development in Turkey: Implications for the 'Academy of New Teachers' programme. Unpublished doctoral dissertation. University of Southampton, Southampton: Great Britain. (Microfilm N. DX 183239).
- Chapman, P. (1990). Survey of First- and Third-Year Teachers and Their Supervisors. U. S. A.: Colorado, (ERIC Document Reproduction Service No. ED332971).
- Choppin, B. H. (1990). Evaluation as a field of inquiry. In H. J. Walberg & G. A. Haertel (Eds), The International Encyclopedia of Educational Evaluation. (pp. 7-8). Oxford: Pergamon Press.
- Coble, C. R. & Koballa, Jr, T. R. (1996). Science Education. In J. Sikula (Ed.), Handbook of Research on Teacher Education (2<sup>nd</sup> Ed.), pp. 171-191, London: Macmillan.
- Cochran, F. K.; DeRuiter, A. J.; & King, A. R. (1993). Pedagogical content knowledge: An integrative model for teacher preparation. Journal of Teacher Education, Vol. 44 (4), pp. 263-272.
- Cohen, C. & Manion, L. (1994). Research Methods in Education. London: Routledge.
- Cook, M. (1992). The open teacher: Experience of student-centred learning, Journal of Teacher Development, Vol. 1 (2), pp. 90-94.
- Corte, E. (2000). Marrying theory building and the improvement of school practice: a permanent challenge for instructional psychology, Learning and Instructional, Vol. 10, pp. 249- 266.
- Creemers, B. P. (1997). Effective Schools and Effective International Perspective, U. K.: University of Warwick, The Centre for Research in Elementary and Primary Education.
- Creemers, B. P. (1994). Effective instruction: an empirical basis for a theory of educational effectiveness. In D. Reynolds; B. Creemers; P. Nesselrodt; E. Schaffer; S. Stringfield and C. Teddlie (authors), Advances in School Effectiveness Research and Practice, Oxford: Elsevier Science Ltd.
- Creswell, J. W. (1994). Research Design: Qualitative and Quantitative Approaches. London: Sage.
- Cruickshank, D. & Metcalf, K. (1990). Training within teacher preparation. In W. R. Houston (Ed.), Handbook of Research on Teacher Education: A Project of the Association of Teacher Education. (pp. 469-497). London: Macmillan.
- Cyril & Poster, D. (1993). Teacher Appraisal, (2<sup>nd</sup> ed.), London: Routledge.
- Davis, B. K. (1983). What is it? Why is it out there? Columbus, OH: Ohio State University. (ERIC Document Reproduction Service No. ED 222-447).
- Denzin, N. K. (1978). The Research Act. New York: McGraw-Hill.
- DfEE (1998). Requirements for Courses of Initial Teacher Training (Circular Number 4/98). London: TTQD.



- Driver, R., Leach, J. Millar, R. & Scott, P. (1999). Perspectives on the nature of science. In E. Scanlon, R. Hill & K. Junker (Eds.), Communicating Science: Professional Contexts, London: Routledge.
- Druva, C. A. & Anderson, R. D. (1983). Science teacher characterises by teacher behavior and by student outcome: A meta-analysis of research. Journal of Research in Science Teaching, Vol. 20 (5), pp. 467-479.
- Dwyer, C. (1993). Teaching and diversity: meeting the challenges for innovative teacher assessment. Journal of Teacher Education, Vol. 44 (2), pp. 119-129.
- Earley, P. (1996). Competence frameworks and profiles for newly-qualified teachers. In D. Hustler & D. McIntyre (Eds.), Developing Competent Teachers: Approaches to Professional Competence in Teacher Education, London: David Fulton Publishers Ltd.
- Edwards, A. & Talbot, R. (1994). Hard-Pressed Researcher, A Research Handbook for the caring Professions, London: Longman Group Limited.
- Edwards, A. (1995). Teacher education: Partnership in pedagogical? Teaching and Teacher Education, Vol. 11 (6), pp. 595-610.
- Eflin, J., Glennan, S. & Reisch, G. (1999). The nature of science: A perspective from the philosophy of science, Journal of Research in Science Teaching, Vol. 36 (1), pp. 107-116.
- Epstein, Irwin, (1988). Quantitative and qualitative methods. In R. M. Grinnell (Ed.), Social Work Research and Evaluation, (3ed Ed.), U. S. A.: F. E. Peacock Publishers.
- Feiman-Nemser, S. (1990). Teacher preparation: structural and conceptual alternatives. In W. R. Houston (Ed.), Handbook of Research on Teacher Education: A Project of the Association of Teacher Education. (pp. 212-233). London: Macmillan.
- Ferguson, P. & Wamack, S. T. (1993). The impact of subject matter and education coursework on teaching performance. Journal of Teacher Education, Vol. 44 (1), pp. 55-63.
- Fish, D. (1995). Quality mentoring for Student Teachers: A Principled Approach to practice. London: David Fulton Publishers.
- Fontana, A. Frey, J. H. (1994). Interviewing, the art science. In N. K. Denzin & U. S. Lincoln (editors), Handbook of Qualitative Research, London: Sage.
- Frame, S. M. (1990). The Effect of Employment Location on Perceptions of Teaching Competencies among First Year Teachers. U. S. A.: Idaho, (ERIC Document Reproduction Service No. ED327517).
- Fraser, M. R. (1998). Critical program components for preparing teachers to educate diverse learners: a national perspective (teacher preparation, elementary education, inclusive education). (Doctoral Dissertation, Illinois State University, 1999). Dissertation Abstracts International, A 59/12.
- Fullan, M. (1991) The new Meaning of Educational Change. (2<sup>nd</sup> ed.), London; Cassel Educational Limited.



- Gallagher, J. J. (2000). Meeting challenges inherent in reform of science teaching and learning, Journal of Research in Science Teaching, Vol. 37 (5), pp. 399-400.
- Galluzzo, G. & Craig, R. (1990). Evaluation of preservice teacher education programs. In W. R. Houseton (Ed ), Handbook of Research on Teacher Education (pp. 599-616). New York, London: Macmillan.
- Garrett, RM. (1989). Promoting creativity through a problem-solving science curriculum, School Science Review, Vol. 70 (252), pp. 127-131.
- Gayford, C. (1992). Patterns of group behaviour in open-ended problem solving in science classes of 15-year-old students in England, International Journal of Science Education, Vol.14 (1), pp. 41-49.
- Geddis, A. (1993). Transforming subject-matter knowledge: The role of pedagogical content knowledge in learning to reflect on teaching. International Journal of Science Education, Vol. 15, pp. 673- 683.
- Gochros, H. L. (1988). Research interviewing. In R. M. Grinnell (Ed.), Social Work Research and Evaluation, (3ed Ed.), U. S. A.: F. E. Peacock Publishers.
- Goffree, F. and Oonk, W. (1999). Educating primary mathematics teachers in the Netherlands: back to the classroom, Journal of Mathematics Teacher Education, Vol. 2, pp. 205-214.
- Greene, M. L. et al (1987). Evaluating the Effectiveness of Alberta's Teachers Education Programs in Preparing Classroom Teachers. Canada, Alberta, (ERIC Document Reproduction Service No. ED280825).
- Grossman, P. & Richert, A. (1988). Unacknowledged knowledge growth: a re-examination of the effects of teacher education. Teaching & Teacher Education, Vol. 4 (1), pp. 53-62.
- Grossman, P. L. (1989). A study in contrast: sources of pedagogical content knowledge for secondary English. Journal of Teacher Education, Vol. 40 (5), pp. 24-31.
- Gustafson, B. F. & Rowell, P. M. (1995). Elementary preservice teacher: constructing conception about learning science, teaching science and the nature of science. International Journal of Science Education, Vol. 17 (5), pp. 589-605.
- Halim, L. (1997). A Critical Appraisal of Secondary Science Teacher Training Programmes on Malaysia with an Emphasis on Pedagogical Content Knowledge. Unpublished doctoral dissertation. King's College, London: Great Britain. (microfilm N. DX 202446).
- Hashweh, M. Z. (1987). Effects of subject-matter knowledge in the teaching of biology and physics. Teaching and Teacher Education, Vol. 3 (2), pp. 109-120.
- Henry, J. (1993). Meaning and practice in experiential leaning. In S. W. Weil & I. McGill (Eds.). Making Sense of Experiential Learning, Open University Press.
- Hewson, P., Tabachnick, R., Zeichner, K. & Lemberger, J. (1999). Education prospective teachers of biology: findings, limitations and recommendations. Science Education, Vol. 83, pp. 373-384.

- Hitchcock, G. & Hughes, D. (1995). Research and the Teacher: A qualitative introduction to school-based research (2<sup>nd</sup>. Ed.). London: Routledge.
- Hodson, D. (1988). Toward a philosophical more valid science curriculum. Science Education, Vol. 72, pp. 19-40.
- Holstein, J. A. & Gubrium, J. F. (1999). Active interviewing. In A. Bryman & R. Burgess (Eds.), Qualitative Research, Vol. (2), London: Sage.
- Hong, E. (1998). Korean and US preservice elementary teachers' conceptions about teaching word problem solving, Journal of Education for Teaching, Vol. 24 (2), pp. 165- 175.
- Hopkins, D. & Stern, D. (1996). Quality teachers, quality schools: international perspectives and policy implications. Teaching & teacher Education, Vol. 12 (5), pp. 501-517.
- Ibraheem, F. & Al Kalza, R. (1996). The Current Curricula. (in Arabic), Alexandria: Almarif.
- Isan, S. (1995). Omani Teacher Qualifying and training in the Sultanate of Oman (Case Study), (in Arabic), Muscat: Ministry of Education.
- Jones, M. (2000). Becoming a secondary teacher in Germany: a trainee perspective on recent development in initial teacher training in Germany, European Journal of Teacher Education. Vol. 23 (1), pp. 65-76.
- Jong, O. D. & Brinkman, F. (1999). Investigating student teachers' conceptions of how to teach: international network studies from science and mathematics education. European Journal of Teacher Education, Vol. 22 (1), pp. 5-9.
- Joyce, B. (1988). Training research and prospective teacher education: A reconsideration. Journal of Teacher Education, Vol. 39 (5), pp. 32-36.
- Kahle, J. and Boome, (2000). Strategies to improve student science learning: implication for science teacher education. Journal of Science Teacher Education, Vol. 11 (2): 93-107.
- Kelly, J. (2000). Rethinking the elementary science methods course: a case for content, pedagogy, and informal science education. International Journal of Science Education, Vol. 22 (7), pp. 755-777.
- Kennedy, J. (1996). Essential elements of initial teacher education courses for science teachers-a survey of tutors in the UK, Research in Science & Technological Education, Vol. 14 (1), pp. 21-32.
- Kuipers, H. & Richardson, R. (1999). Active qualitative evaluation, core elements and procedure. Evaluation, Vol. 5 (1), pp. 61-79.
- Kumar, R. (1996). Research Methodology, London: Sage.
- Kyriacou, C. (1995). Essential Teaching Skills, (3<sup>rd</sup> Ed.), U.K.: Stanley Thornes.



- Leach, J.; Driver, R.; Millar, R. and Scott, P. (1997). A study of progression in learning about 'the nature of science': issues of conceptualisation and methodology, International Journal of Science Education, Vol. 19 (2), pp. 147-166.
- Lederman, N. G. (1999). Teachers' understanding of the nature of science and classroom practice: factors that facilitate or impede the relationship, Journal of Research in Science Teaching, Vol. 36 (8), pp. 916-929.
- Likert, R. (1932). A Technique for the Measurement of Attitudes. Archives of Psychology No. 140.
- Lincoln, Y. S. & Guba, E. G. (1985). Naturalistic Inquiry. Newbury Park: Sage.
- Luft, J. A. (1999). Teachers' salient beliefs about a problem solving demonstration classroom in-service program, Journal of Research in Science Teaching, Vol. 36 (2), pp. 141-158.
- Manning, P. Cullum-Swan, B. (1994). Narrative, content, and semiotic analysis, In N. K. Denzin & U. S. Lincoln (editors), Handbook of Qualitative Research, London: Sage.
- Manouchehri, A. (1997). School mathematics reform: implication for mathematics teacher preparation, Journal of Teacher Education, Vol. 48 (3), pp.197-209.
- Marxwell, J. (1998). Designing a Qualitative Study. In Bickman, L. & Rog, D. (Eds), Handbook of Applied Social Research Methods. London: Sage.
- May, T. (1997) Social Research: Issues, Methods and Process. (2<sup>nd</sup> ed.), Buckingham: Open University Press.
- McDevitt, T.; Gardner, A.; Shaklee, J.; Bertholf, M. & Troyer, R. (1999). Science and mathematics instruction of beginning elementary teachers. Journal of Science Teacher Education, Vol. 10 (3): 217-233.
- McIntyre, D. J.; Byrd, D. M. & Foxx, S. M. (1996). Field and laboratory experiences. In J. Sikula (Ed.), Handbook of Research on Teacher Education (2<sup>nd</sup> Ed.), pp. 171-191, London: Macmillan.
- Mellado, V. (1998). The classroom practice of preservice teachers and their conceptions of teaching and learning science, Science Education, Vol. 82, pp. 197-214.
- Mertens, D. M. (1998). Research Methods on Education and Psychology: Integrating Diversity with Quantitative & Qualitative Approaches. Thousand Oaks: Sage.
- Mifsud, C. (1996). Preparation and competence of intending and beginning teachers in Malta. Journal of Education for Teaching, Vol. 22 (3), pp.283-296.
- Mills, S. & Tillman C. (1994, February). Adapting Instruction to Individual Learner Differences: A Research Paradigm for Computer-Based Instruction. Paper presented at the national convention of the Association for Educational Communications and Technology, Nashville, TN. (ERIC Document Reproduction Service No. ED 373740).
- Mindel, C. H. & McDonald, L. (1988). Survey research. In R. M. Grinnell (Ed.), Social Work Research and Evaluation, (3ed Ed.), U. S. A.: F. E. Peacock Publishers.

- Ministry of Development (1995). Oman 2020, Vision for Oman's Economy, (in Arabic), Muscat: Oman Printers & Stationers.
- Ministry of Education (15/5/2002). The Home Page of the Ministry of Education, Oman: [www.edu.gov.om](http://www.edu.gov.om)
- Ministry of Education (1995) Reform and Development of General Education, Oman, Muscat: (unpublished document).
- Ministry of education (1997a). Basic Education Schools' Guide, Sultanate of Oman: Ministry of Education.
- Ministry of Education (1997b). Vision and Reform of Education in the Sultanate of Oman . Sultanate of Oman: Ministry of Education.
- Ministry of Education (1998). Science and Technology: a curriculum guide for teachers, Sultanate of Oman.
- Ministry of Education (1999a), Curriculum Framework (Science and Mathematics). Unpublished document, Sultanate of Oman.
- Ministry of Education (1999b). Assessment and Evaluation Guide for Teachers. Unpublished document, Sultanate of Oman.
- Ministry of Education (2001). Teacher' Guide for Science Subject, (in Arabic), Ministry of Education, Oman.
- Ministry of Higher Education (1996). The Programmes of Teacher Preparation for Preparatory and Secondary Schools. (in Arabic), Unpublished document, Sultanate of Oman.
- Ministry of Higher Education (1998a). Course Description: for Educational Courses, (in Arabic), Unpublished Document, Sultanate of Oman.
- Ministry of Higher Education (1998b). Course Description: for Practicum Courses. Unpublished document, Sultanate of Oman.
- Ministry of Higher Education (1999). Student Teachers' Registration Records, Ministry of Higher Education, Oman.
- Ministry of Higher Education (2000). Assessment Form of the Practicum, (in Arabic), Ministry of Higher education, Oman.
- Ministry of Information (1990). Oman 90, Muscat: Mazoon Printing Press.
- Ministry of Information (1991). Oman 91, Muscat: Mazoon Printing Press.
- Ministry of Information (1995). Oman 95, Muscat: International Printing Press.
- Ministry of Information (1999). Oman 98/99. Muscat: Mazoon Printing Press.
- Mitzel, H. (ed.), (1982a). Evaluation of programs, In Encyclopaedia of Educational Research, (5<sup>th</sup> Ed.), Vol., (2), pp. 592-611, London: Macmillan.



- Mitzel, H. (ed.), (1982b). Teacher effectiveness, In Encyclopaedia of Educational Research, (5<sup>th</sup> Ed), Vol. (4), pp. 1894-1903, London: Macmillan.
- Montgomery, D. (1999). Teacher Appraisal Through Classroom Observation, London: Fulton.
- Mouly, G. (1978). Educational Research: The Art and science of Investigation. Boston: Allyn & Bacon, Inc.
- Murray, A. H. (1990). Teacher Evaluation Status in the Forty-Two School Districts of New Brunswick, Canada, as Perceived by Superintendents, 1988-89 School Year. Doctoral Dissertation, Brigham Young University, 1989). Dissertation Abstracts International, A 50/10.
- Nettle, E. B. (1998). Stability and change in the beliefs of student teachers during practice teaching. Teaching and Teacher Education, Vol. 14 (2), pp. 193-204.
- Padgett, D. K. (1998). Qualitative Methods in Social Work Research, Challenges and Rewards. U. S. A.: Sage Publications.
- Palmquist, B. & Finley, F. (1997). Preservice teachers' views of the nature of science during a postbaccalaureate science teaching program, Journal of Research in Science Teaching, Vol. 34 (6), pp. 595-615.
- Parkinson, J. (1994). School-based teacher training and the mentor, Education in Chemistry, Vol. 31 (6), pp. 154-156.
- Parkinson, J. (1998). The difficulties in developing information technology competencies with student science teachers, Research in Science & Technological Education, Vol. 16 (1), pp. 67-78.
- Patrick, J. & Smart, R. (1998). An empirical evaluation of teacher effectiveness: the emergence of three critical factors. Assessment & Evaluation in Higher Education, Vol. 23 (2), pp. 165-189.
- Patton, M. (1990). Qualitative Evaluation and Research Methods. London: Sage.
- Pedersen, J. and Yerrick, R. (2000). Technology in science teacher education: survey of current use and desired knowledge among science educators. Journal of Science Teacher Education, Vol. 11 (2), pp. 131-153.
- Pehkonen, E. (1993). What are Finnish teacher educators' conceptions about the teaching of problem solving in mathematics? European Journal of Teacher Education, Vol.16 (3), pp. 237-254.
- Peterson, R. & Treagust, D.(1998), Learning to teach primary science through problem-based learning. Science Education, 82, pp. 215-237.
- Pierce, C. M. (1991). A Profile of an Effective Teacher: A Microethnography of A Seventh-Grade Social Studies Classroom (Teacher Effectiveness). (Doctoral Dissertation, The University of Alabama, 1990). Dissertation Abstracts International, A 52/02.
- Plummer, D. and Barrow, L. (1998). Ways to support beginning science teachers, Journal of Science Teacher Education, Vol. 9 (4), pp. 293-301



- Popham, w. J. (1988). Educational Evaluation. (2<sup>nd</sup> Ed.). New Jersey: Prentice Hall.
- Punch, K. F. (1998). Interdiction to Social Research , Qualitative & Quantitative Approaches, London: Sage.
- Rask, H. (1995). Just a nod and a wink: collaborative skills developed in collaborative ways with early years student teachers. In D. Fish (Ed.), Quality Learning for Student Teachers, London: David Fulton Publishers.
- Robinson, M. (1999). Initial teacher education in a changing South Africa: experiences, reflections and challenges, Journal for Education for Teaching, Vol. 25 (3), pp. 191-201.
- Robson, C. (1993). Real World Research: A Resource for Social Scientists and practitioner-researchers. Oxford: Blackwell.
- San, M. M. (1999). Japanese beginning teachers' perceptions of their preparation and professional development, Journal of Education for Teaching, Vol. 25 (1), pp. 17-29.
- Schmidinger, E. (1996). Teaching practice in pre-service education: international exchange, European Journal of Teacher Education, Vol. 19 (3), pp. 351-352.
- Scroggie, F.; Bader, Q.; & Khilifah, G. (1997). Teacher professionalism: school and college collaboration. In ICET, International Yearbook on Teacher Education, Vol (1), pp. 255-283, Sultanate of Oman: Mazoon Printing Press.
- Seaberg, J. (1988) Utilizing sampling procedures. In R. M. Grinnell (Ed.), Social Work Research and Evaluation, (3ed Ed.), U. S. A.: F. E. Peacock Publishers.
- Shulman, L. (1986). Those who understand: Knowledge growth in teaching. Educational Researcher, Vol. 15 (2), pp. 4-14.
- Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. Harvard Education Review, Vol. 57 (1), pp. 1-22.
- Smyth, J. (1987). Introduction: Educating teachers; changing the nature of pedagogical knowledge. In J. Smyth (Ed.), Educating Teachers, pp. 1-5, London: Falmer.
- Spiegel, S. A. (1998) Understanding Science Teacher Enhancement Programs: Essential Components and a Model. (Doctoral Dissertation, The Florida State University, 1997), Distention Abstracts International, A 85/10.
- Stones, E. (1994). Quality Teaching, London: Routledge.
- Strawderman, C. & Lindsey, P. (1995). Keeping up with the times: reform in teacher education. Journal of Teacher Education, Vol.46 (2), pp. 95-100.
- Stufflebeam, D. L. (1983). The CIPP model for program evaluation. In G. F. Madaus, M. S. Scriven & D. L. Stufflebeam (Eds.), Evaluation Models, Viewpoints on Educational and Human Evaluation, Boston: Kluwer-Nijhoff Publishing.
- Sultana, R. G. (1995). Developing a vision for teacher education programmes: A values-based approach. European Journal of Teacher Education, Vol. 18 (2/3), pp. 215-229.

SQU (2002). The Website of the Sultan Qaboos University: www.squ.edu.om.

Taib, M. N. (1997). Principles and Practice of Reflective Teaching in the Pre-Service Teacher Education Programme of Malaysian Teacher Training Colleges. Unpublished doctoral dissertation. Sheffield University, Sheffield: Great Britain. (Microfilm N. DX 205429).

The Partnership Office (2001/2), Warwick partnership for initial teacher training, In Handbook for Training in Science Secondary Schools 2001-2002: the University of Warwick.

Thompson, D. E. (1984, December). Improved teacher preparation through increased field experience. Paper presented at the American Vocational Association Convention. New Orleans, LA. (ERIC Document Reproduction Service No. ED 252 725).

TTA (1998). Initial Teacher Training National Curriculum for Primary Science. Teacher Training Agency: Annex E of DfEE Circular 4/98.

TTA (1999). The Use of Information and Communications Technology in Subject Teaching, Teacher Training Agency: London.

University of Warwick (1998). Warwick partnership for initial teacher training. in Handbook for Training in Schools.

Veenman, S. et al (1995). Effective Instruction: Effects of a Pre-service Teacher Preparation Program for Secondary Schools. Netherlands, (ERIC Document Reproduction Service No. ED388655).

Vesilind, E. M. & Jones, M. G. (1996). Hands-on: Science education reform, Journal of Teacher Education, Vol. 47 (5), pp. 375- 385.

Warham, S. (1993). Reflections on Hegemony: towards a model of teacher competence. Educational Studies, Vol. 19 (2), pp. 205-217.

Webber, S. L. (1996). Demand and supply: Meeting the need for teachers in the 'new' Russian school, Journal of Education for Teaching, Vol. 22 (1), pp.9-26.

Webbstock, D. (1999). An evaluation look at the model used in the assessment of teaching quality at the University of Natal, South Africa: reflections, rewards and reconsiderations. Assessment & Evaluation in Higher Education, Vol. 24 (2), pp. 157-179.

Wilson, S. & Cameron, R. (1996). Student teacher perceptions of effective teaching: a developmental perspective. Journal of Education for Teaching, Vol. 22 (2), pp. 181-195.

Wise, V. L.; Spiegel, A. N.; and Bruning, R. H. (1999). Using teacher reflective practice to evaluate professional development in mathematics and science, Journal of Teacher Education, Vol. 50 (1), pp. 42-49.

Wolf, R. M. (1990). The nature of educational evaluation. In H. J. Walberg & G. A. Haertel (Eds), The International Encyclopedia of Educational Evaluation. (pp. 8-15). Oxford: Pergamon Press.



Yager, R., Hidayat, E. and Penick, J. (1988). Features which separate least effective from most effective teachers. Journal of research in Science Teaching, Vol. 25, pp.165-177.

Zeichner, K., & Gore, J. (1990). Teacher socialization. In W. Houston, M. Haberman, & J. Sikula (Eds), Handbook of research on Teacher Education (pp. 329-48). New York: Macmillan.



## Appendixes

### Appendix (1) Science Topics for Basic Education (Grade 1 to 10)

<b>Grade 1</b> Animals Plants Toys Air Water	<b>Grade 2</b> Our senses Magnets Sound Light, Colour, and Shadow Look and See
<b>Grade 3</b> Plant and Animal Characteristics Exploring Matter Human Health and Safety Building Structures	<b>Grade 4</b> Plant Growth and Change Light Habitats Rocks, Minerals, and Soil Simple Machines
<b>Grade 5</b> Interdependence of Living Organisation Maintaining a Healthy Body Matter and Change Forces and Machines Astronomy	<b>Grade 6</b> Micro-organisms Ecosystems Electricity Heat Flight/Space Technology
<b>Grade 7</b> Living Organisation – Characteristics and Classification Matter and its Properties Sound Conservation and Energy	<b>Grade 8</b> Human Body: Structure and Function of Systems Force, Energy and Machines Solutions Water Systems
<b>Grade 9</b> Cells –Structure and Function Plants – Structure and Function Matter and Change Optics – Light and Colour Applied Chemistry	<b>Grade 10</b> Interactions in Ecosystems Organisms – Their External and Internal Environments Nutrition Waste Management Atomic Structure and Bonding Electricity Heat Astronomy Genetics

## Appendix (2): The Questionnaire, which was applied to student science teachers

Dear student science teacher

The Ministry of Education started to apply the reformed general education system. It hopes that teachers graduating from the colleges of education are adequately prepared to teach in the system. **Have you been prepared and equipped in your pre-service training programme for this system?** Answering this question is the main aim of the current research that I am doing for my study at the University of Warwick, the outcomes of which will hopefully help in providing better training in the future.

Attached you will find a questionnaire which I am asking you to complete. Be assured that your responses will be kept anonymous and confidential and will be used for research purposes only. If you are willing to be consulted for a follow up interview, please include the phone number. So feel free to answer each item of the questionnaire confidentially.

Your cooperation and time are highly appreciated.

### SECTION ONE: General Information

Please choose one answer for each of the following:

1. Name and phone number (optional): .....

2. College:

Nizwa	
Salalah	

Ibri	
Sur	

Suhar	
Ristaq	

3. Gender:

Male	
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Female	
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4. Major specialisation:

Physics/computer	
Chemistry/physics	

Physics/mathematics	
Chemistry/biology	

Physics/chemistry	
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5. Grade in the last term

A	
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B	
---	--

C	
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D	
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## Section Two: Teacher's competencies in teaching science

Read the following statements carefully. Please circle one number for each statement that indicate your level of ability to:

Not competent=1 Competent=5

	1	2	3	4	5
1. Relate science with pupils' everyday life	1	2	3	4	5
2. Integrate science with other subjects	1	2	3	4	5
3. Relate science with the local environment	1	2	3	4	5
4. Recognise pupils' individual needs and provide appropriate activities for them	1	2	3	4	5
5. Take into account pupils' prior experience in the planning and teaching of lessons	1	2	3	4	5
6. Incorporate activities that are not included in science teacher guides	1	2	3	4	5
7. Ask questions that challenge pupils' thinking	1	2	3	4	5
8. Manage the learning environment to allow pupil-centred learning to take place	1	2	3	4	5
9. Encourage pupils to take initiative in their own learning	1	2	3	4	5
10. Develop pupils' communication skills through pupil-centred learning	1	2	3	4	5
11. Encourage pupils to develop process skills in science such as observing, classifying, communicating, predicting and experimenting	1	2	3	4	5
12. Guide pupils to use collaborative learning in science	1	2	3	4	5
13. Encourage pupils to learn and understand science by doing	1	2	3	4	5
14. Create opportunities for self-learning	1	2	3	4	5
15. Suggest homework that reinforces learning	1	2	3	4	5
16. Organise field work and visits	1	2	3	4	5
17. Organise science learning through games	1	2	3	4	5
18. Use information and communication technology	1	2	3	4	5
19. Use problem-solving methods	1	2	3	4	5
20. Use a variety of print and non-print resources such as kits, games, manipulative materials, computer software	1	2	3	4	5

21. What are your views on the benefits of teaching science with ICT?

22. a) What are your opinions on the new trends of the Ministry of Education in developing the teaching of science through experiential learning methods (pupil-centred learning) in the basic education?



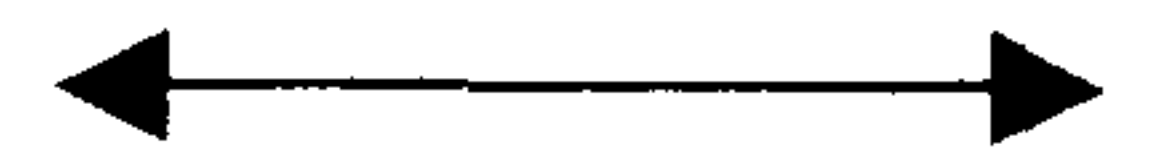
- b) Are you able to use them effectively?
- c) If yes, please indicate the methods of experiential learning that you use in your teaching.
- d) If not, please explain why not?

### Section Three: Science Teachers' Skills in Assessment and Evaluation

Read the following statements carefully. Please circle one number for each statement that indicates your level of ability to:

Not competent=1

Competent=5



1. set tasks that are closely linked to the learning outcomes and objectives	1	2	3	4	5
2. Measure higher cognitive skills in science (evaluation, synthesis, analysis)	1	2	3	4	5
3. Consider each pupil's individual learning style in the assessment	1	2	3	4	5
4. Use a variety of assessment methods (observation, interviews, reports, self-assessment, achievement tests)	1	2	3	4	5
5. Assess the understanding of the problem-solving process	1	2	3	4	5
6. Guide pupils to use self-assessment sheets which allow them to become involved in their own assessment					
7. Use a computer to record the pupils' examination results	1	2	3	4	5
8. Analyse pupils' examination results	1	2	3	4	5
9. Write clear reports of pupils' achievements or progress	1	2	3	4	5
10. Use the assessment results in evaluating teaching methods and course contents	1	2	3	4	5
11. Provide appropriate feedback to pupils	1	2	3	4	5

12. a) What are your opinions of the new trends of the Ministry of Education in using different methods to assess pupils in science?

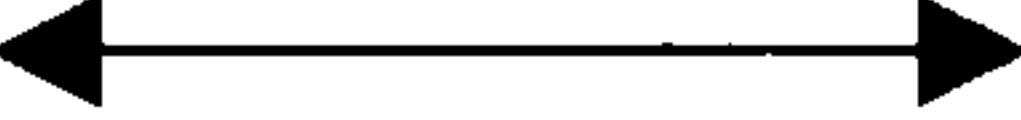
- b) Are you able to use them effectively?
- c) If yes, please indicate the tools that you are able to use them in your teaching.
- d) If not, please explain why not?

### Section Four: Problem-solving Skills

This section is about your abilities/skills in designing and implementing a problem-centred approach in teaching. Read the following statements carefully. Please circle one number for each statement that indicates your level of ability to:

Not competent =1

Competent =5

					
1. Present problems that are based on the pupils' interests	1	2	3	4	5
2. Present problems in a meaningful and relevant context	1	2	3	4	5
3. Incorporate thinking skills into the lessons	1	2	3	4	5
4. Provide open-ended tasks	1	2	3	4	5
5. Identify pupils' prior knowledge needed to solve the problems	1	2	3	4	5
6. Provide hands-on activities	1	2	3	4	5
7. Design lessons that incorporate pupils' planning as part of their problem-solving	1	2	3	4	5
8. Provide pupils with a variety of printed and non-printed resources	1	2	3	4	5
9. Encourage pupils to research and use materials other than those provided by me	1	2	3	4	5
10. Extend pupils' learning by posing open-ended questions	1	2	3	4	5
11. Ask questions in a variety of ways	1	2	3	4	5
12. Probe pupils' answers	1	2	3	4	5
13. Focus on developing the pupils' reasoning skills, rather than the correctness of the answers	1	2	3	4	5
14. Modify science lessons to follow the interest of the pupils	1	2	3	4	5
15. Raise pupils' self-esteem	1	2	3	4	5

16. What are the strengths and the weakness of the problem-solving methods?

## SECTION FIVE: Pedagogical Courses

Write the number that indicates the degree to which you think each of the required courses is **important and effective** in preparing you to teach science. Use the following scale:

**Not important/not effective = 1**

**Only slightly important/effective = 2**

**Important/effective = 3**

**Very important/very effective = 4**

**Extremely important/extremely effective = 5**

The course	Importance	Effectiveness	The course	Importance	Effectiveness
1. Education foundation			7. School management		
2. Research foundation & statistics			8. Comparative educational systems		
3. Educational psychology			9. Development psychology		
4. Educational evaluation & psychological assessment			10. Science teaching methods		
5. Curriculum			11. Elective course in education		
6. Educational technology					

12. What do you consider to be the most important strengths in the pedagogical courses?

13. What do you consider to be the most important weaknesses in the pedagogical courses?

14. How can the effectiveness of these courses be improved to meet the requirements of the reformed general education of the Ministry of Education?



## SECTION SIX: Practicum Aspects

Write the number that indicates the degree to which you think each of the required aspects is **important and effective** in preparing you to teach science. Use the following scale:

**Not important/not effective = 1**

**Only slightly important/effective = 2**

**Important/effective = 3**

**Very important/very effective = 4**

**Extremely important/extremely effective = 5**

The course	Importance	Effectiveness	The course	Importance	Effectiveness
1. Planning competency workshop			10. Observation teaching period		
2. Instructional strategies competency workshop			11. Serial practicum		
3. Classroom management workshop			12. Block practicum		
4. Linguistic skills competency workshop			13. College supervisors' feedback		
5. Evaluation competency workshop			14. The role of principals at schools		
6. Curriculum content mastering competency workshop			15. Schools environment		
7. Instructional technology competency workshop			16. Participating in the school activities		
8. Administration duty visits			17. The role of the mentor		
9. Micro-teaching sessions					

18. What are the greatest benefits of the practicum in preparing you to be an effective teacher?

19. What are the least useful aspects of the practicum?

20. What are your suggestions to develop the practicum to be more effective to meet the requirements of the reformed general education of the Ministry of Education?

### **Other questions**

1. What are your opinions on the distribution of the credit hours of the programme into 55% for specialisation, 25% for professional and cultural courses, and 20% for practicum?

2. Please indicate any suggestions or recommendations that you feel might contribute to improving the science teacher programme at the Colleges of Education.

**Thank you very much for answering the questionnaire**

### Appendix (3): The Questionnaire, which was applied to teacher educators

Dear Dr:

The Ministry of Education started to apply the reformed general education system. It hopes that teachers graduating from the colleges of education are adequately prepared to teach in the system. **Have the science teachers been prepared and equipped in their pre-service training programme for this system?** Answering this question is the main aim of the current research that I am doing for my study at the University of Warwick in the United Kingdom, the outcomes of which will hopefully help in providing better training in the future.

Attached you will find a questionnaire which I am asking you to complete. Be assured that your responses will be kept anonymous and confidential and will be used for research purposes only. If you are willing to be consulted for a follow up interview, please include the phone number. So feel free to answer each item of the questionnaire confidentially.

Your cooperation and time are highly appreciated.

#### SECTION ONE: General Information

Please choose one answer for each of the following:

1. Name and phone number (optional): .....

2. College:

Nizwa	
Salalah	

Ibri	
Ristaq	

Suhar	
Sur	

3. Gender:

Male	
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Female	
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4. Specialisation:

Curriculum and teaching methodologies	
--	--

Psychology	
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Educational administration	
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**Note: Please answer the sections that are related to you.**



## Section Two: Teacher's Skills of teaching science

Read the following statements carefully. Please circle one number for each statement that indicates the science teachers' level of ability to:

5= competent, 1= not competent

	←—————→				
1. Relate science with pupils' everyday life	1	2	3	4	5
2. Integrate science with other subjects	1	2	3	4	5
3. Relate science with the local environment	1	2	3	4	5
4. Recognise pupils' individual needs and provide appropriate activities for them	1	2	3	4	5
5. Take into account pupils' prior experience in the planning and teaching of lessons	1	2	3	4	5
6. Incorporate activities that are not included in science teacher guides	1	2	3	4	5
7. Ask questions that challenge pupils' thinking	1	2	3	4	5
8. Manage the learning environment to allow pupil-centred learning to take place	1	2	3	4	5
9. Encourage pupils to take initiative in their own learning	1	2	3	4	5
10. Develop pupils' communication skills through pupil-centred learning	1	2	3	4	5
11. Encourage pupils to develop process skills in science such as observing, classifying, communicating, predicting and experimenting	1	2	3	4	5
12. Guide pupils to use collaborative learning in science	1	2	3	4	5
13. Encourage pupils to learn and understand science by doing	1	2	3	4	5
14. Create opportunities for self-learning	1	2	3	4	5
15. Suggest homework that reinforces learning	1	2	3	4	5
16. Organise field work and visits	1	2	3	4	5
17. Organise science learning through games	1	2	3	4	5
18. Use information and communication technology	1	2	3	4	5
19. Use problem-solving methods	1	2	3	4	5
20. Use a variety of print and non-print resources such as kits, games, manipulative materials, computer software	1	2	3	4	5

21. a) Do you think they are able to teach in the reformed general education by using experiential learning methods (pupil-centred learning)?

b) If yes, what methods they can use effectively?

c) If not, why do they not use them?

### Section Three: Science Teachers' Skills in Assessment and Evaluation

Read the following statements carefully. Please circle one number for each statement that indicates the science teachers' level of ability to:

Not competent =1

Competent =5

	←—————→				
	1	2	3	4	5
1. Set tasks that are closely linked to the learning outcomes and objectives	1	2	3	4	5
2. Measure higher cognitive skills in science (evaluation, synthesis, analysis)	1	2	3	4	5
3. Consider each pupil's individual learning style in the assessment	1	2	3	4	5
4. Use a variety of assessment methods (observation, interviews, reports, self-assessment, achievement tests)	1	2	3	4	5
5. Assess the understanding of the problem-solving process	1	2	3	4	5
6. Guide pupils to use self-assessment sheets which allow them to become involved in their own assessment					
7. Use a computer to record the pupils' examination results	1	2	3	4	5
8. Analyse pupils' examination results	1	2	3	4	5
9. Write clear reports of pupils' achievements or progress	1	2	3	4	5
10. Use the assessment results in evaluating teaching methods and course contents	1	2	3	4	5
11. Provide appropriate feedback to pupils	1	2	3	4	5

12. a) Are they able to use different assessment tools recommended by the reformed general education?

b) If yes, what assessment tools do they use in their teaching?

c) If not, why?

## Section Four: Problem-solving Skills

This section is about science teachers' abilities/skills in designing and implementing a problem-centred approach in teaching. Read the following statements carefully. Please circle one number for each statement that indicates their level of ability to:

Not competent =1

Competent =5

	←————→				
1. Present problems that are based on the pupils' interests	1	2	3	4	5
2. Present problems in a meaningful and relevant context	1	2	3	4	5
3. Incorporate thinking skills into the lessons	1	2	3	4	5
4. Provide open-ended tasks	1	2	3	4	5
5. Identify pupils' prior knowledge needed to solve the problems	1	2	3	4	5
6. Provide hands-on activities	1	2	3	4	5
7. Design lessons that incorporate pupils' planning as part of their problem-solving	1	2	3	4	5
8. Provide pupils with a variety of printed and non-printed resources	1	2	3	4	5
9. Encourage pupils to research and use materials other than those provided by student teachers	1	2	3	4	5
10. Extend pupils' learning by posing open-ended questions	1	2	3	4	5
11. Ask questions in a variety of ways	1	2	3	4	5
12. Probe pupils' answers	1	2	3	4	5
13. Focus on developing the pupils' reasoning skills, rather than the correctness of the answers					
14. Modify science lessons to follow the interest of the pupils	1	2	3	4	5
15. Raise pupils' self-esteem	1	2	3	4	5

16. Are they able to effectively teach by using problem-solving methods? If not, why?



**SECTION FIVE: Pedagogical Courses**

Write the number that indicates the degree to which you think each of the required courses is **important and effective** in preparing science teachers to teach science. Use the following scale:

**Not important/not effective = 1**

**Only slightly important/effective = 2**

**Important/effective = 3**

**Very important/very effective = 4**

**Extremely important/extremely effective = 5**

The course	Importance	Effectiveness	The course	Importance	Effectiveness
1. Education foundation			7. School management		
2. Research foundation & statistics			8. Comparative educational systems		
3. Educational psychology			9. Development psychology		
4. Educational evaluation & psychological assessment			10. Science teaching methods		
5. Curriculum			11. Elective course in education		
6. Educational technology					

12. What do you consider to be the most important strengths in the pedagogical courses?

13. What do you consider to be the most important weaknesses in the pedagogical courses?

14. How can the effectiveness of these courses be improved to meet the requirements of the reformed general education of the Ministry of Education?

## SECTION SIX: Practicum Aspects

Write the number that indicates the degree to which you think each of the required aspects is **important and effective** in preparing science teachers to teach science. Use the following scale:

Not important/not effective = 1

Only slightly important/effective = 2

Important/effective = 3

Very important/very effective = 4

Extremely important/extremely effective = 5

The course	Importance	Effectiveness	The course	Importance	Effectiveness
1. Planning competency workshop			10. Observation teaching period		
2. Instructional strategies competency workshop			11. Serial practicum		
3. Classroom management workshop			12. Block practicum		
4. Linguistic skills competency workshop			13. College supervisors' feedback		
5. Evaluation competency workshop			14. The role of principals at schools		
6. Curriculum content mastering competency workshop			15. Schools environment		
7. Instructional technology competency workshop			16. Participating in the school activities		
8. Administration duty visits			17. The role of the co-operating teacher		
9. Micro-teaching sessions					

18. What are the greatest benefits of the practicum in preparing science teachers to be an effective teacher?

19. What are the least useful aspects of the practicum?

20. What are your suggestions to develop the practicum to be more effective to meet the requirements of the reformed general education of the Ministry of Education?

**Other questions:**

1. What are your opinions on the distribution of the credit hours of the programme into 55% for specialisation, 25% for professional and cultural courses, and 20% for practicum?
2. Please indicate any suggestions or recommendations that you feel might contribute to improving the science teacher programme at the Colleges of Education.

**Thank you very much for answering the questionnaire**



## **Appendix (4): Student teachers and teacher's interview schedule**

The interview covered the following:

**One) General Information:** student teacher and teacher's name, gender, specialisation, college and the year of graduation.

**Two) Teacher' skills:**

1. What are your views of the new trends of the Ministry of Education in developing the teaching of science through experiential learning methods (pupil-centred learning), in teaching science in the Basic Education?

1:1. Have you been trained to teach by these methods during your study at the College of Education?

2. What are your opinions on using ICT in teaching science? Can you use ICT in your teaching?

3. Can you use problem-solving methods in your teaching?

4. What are your opinions on the new trends of the Ministry of Education in using different assessment strategies in the evaluation of pupils? Have you been trained to use them?

**Three) Pedagogical courses:**

This section included the following:

1. The most important strengths of them;
2. The most important weaknesses of them;
3. How can these courses be developed to meet the requirements of the reformed system?

**Four) Practicum aspects:**

This section included the following:

1. The greatest benefits of the practicum;
2. The least useful aspects of the practicum;
3. Teacher' suggestions to develop the practicum to meet the demands of the reformed system.

**Five) other questions**

1. What are your opinions on the distribution of the credit hours of the programme into 55% for specialisation courses, 25% for professional and cultural courses, and 20% for practicum?
2. Do you have any other general points you wish to add?

## **Appendix (5): Teacher educators' interview schedule**

The interview covered the following:

**One) General information:** educator's name, college and specialisation

**Two) Teacher skills:**

1. Do you think science teachers graduating from colleges of education are able to teach in the reformed general education by using experiential learning methods, in teaching science?
2. Are the teachers able to teach by using problem-solving methods?
3. Do you think they are able to use ICT in their teaching?
4. Could you describe their ability to assess pupils by using different assessment tools that are recommended by the Ministry of Education for the Basic Education?

**Three) Pedagogical courses:**

This section included the following:

1. The most important strengths of them;
2. The most important weaknesses of them;
3. How can these courses be developed to meet the requirements of the reformed system?

**Four) Practicum aspects:**

This section included the following:

1. The greatest benefits of the practicum;
2. The least useful aspects of the practicum;
3. Educator' suggestions to develop the practicum to meet the demands of the reformed system.

**Five) other questions**

1. What are your opinions on the distribution of the credit hours of the programme into 55% for specialisation courses, 25% for professional and cultural courses, and 20% for practicum?
2. Do you have any other general points you wish to add?

**Appendix (6): *t* test for the significant differences between the importance and effectiveness of pedagogical course**

Pedagogical courses	Educators			Student teachers		
	Importance	Effectiveness	t*	Importance	Effectiveness	t*
Education foundation	3.82	3.15	5.136*	3.29	1.71	23.468*
Research foundation & statistics	4.26	3.03	7.870*	4.23	2.83	23.823*
Educational psychology	4.24	2.93	8.394*	3.74	2.26	24.606*
Educational evaluation & psychological assessment	4.34	3.10	8.394*	4.13	2.76	20.146*
Curriculum	4.22	3.31	13.106*	3.58	2.37	19.421*
Educational technology	4.49	3.41	10.911*	4.56	2.62	26.327*
School management	3.88	3.08	5.879*	3.97	2.32	22.377*
Comparative educational systems	3.50	2.96	5.477*	3.43	2.21	17.278*
Development psychology	4.14	3.22	7.342*	4.18	2.78	22.621*
Science teaching methods	4.78	3.79	8.972*	4.77	3.48	23.138*
Elective course in education	3.25	2.43	7.081*	3.20	1.87	18.881*

5-point scale: 1= the lowest, 5= the highest. \*: significant  $p < 0.001$  for all comparisons



**Appendix (7): *t* test for the significant differences between the importance and effectiveness of practicum aspects**

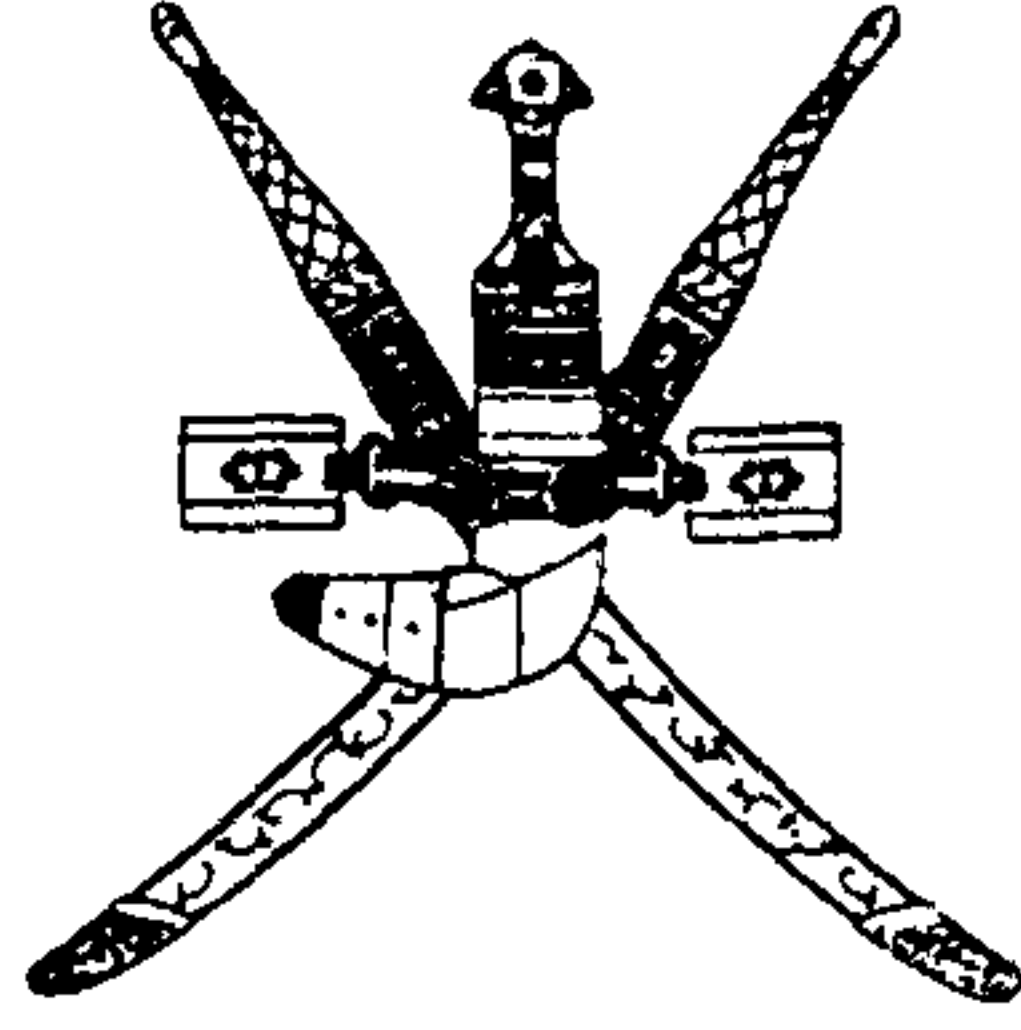
Practicum aspects	Student teachers			Educators		
	Importance	Effectiveness	T*	Importance	Effectiveness	t*
Planning competency workshop	3.75	2.25	23.090*	4.23	3.33	11.464*
Instructional strategies competency workshop	3.80	2.13	26.219*	4.53	3.47	10.954*
Classroom management workshop	3.86	2.07	25.392*	3.85	3.26	5.564*
Evaluation competency workshop	3.92	2.29	23.146*	4.33	3.18	9.053*
Curriculum content mastering competency workshop	4.40	2.31	30.609*	4.60	3.17	13.229*
Instructional technology competency workshop	4.40	2.36	30.146*	4.28	3.18	13.715*
Administration duty visits	2.63	2.52	1.063	2.82	3.17	3.978*
Micro-teaching sessions	4.14	2.62	22.513*	4.58	3.29	17.889*
Observation teaching period	3.94	2.66	18.612*	4.00	2.47	11.236*
Serial practicum	3.86	3.25	9.789*	4.42	3.16	12.470*
Block practicum	4.43	3.67	12.449*	4.75	3.03	16.663*
College supervisors' feedback	4.45	3.45	13.686*	4.52	3.69	7.378*
The role of principals at schools	3.18	2.24	11.438*	3.09	2.15	9.757*
Schools environment	4.15	2.96	16.802*	4.25	3.26	11.726*
Participating in the school activities	4.13	2.49	24.622*	4.12	2.75	14.931*
The role of monitor	4.28	1.56	50.066*	4.32	1.44	39.490*

5-point scale: 1= the lowest, 5= the highest, \*: significant,  $p < 0.001$  for all comparisons

**Appendix (8a, 8b, and 8c): The letters of authorisation from the Ministry of Higher Education and the Ministry of Education.**

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

مِنَّا  
وَأَمْرًا  
وَالْعَالَمِينَ



الرقم: د. د. ع. / ٢٩٨

الرقم: د. د. ع. / ٣ / ١٤٤٤

شهادة لمن يهمله الأمر

تشهد دائرة الدراسات العليا بوزارة التعليم العالي بأن الفاضل / **عبدالله بن سيف بن محمد التويهي** مبتعث من قبل وزارة التعليم العالي لمواصلة دراسته العليا للحصول على درجة الدكتوراه في مجال المناهج وطرق تدريس الأحياء بـ University of Warwick ويقوم حالياً بإعداد بحث بعنوان (دراسة تقييمية لبرنامج إعداد معلمي العلوم بكليات التربية للمعلمين والمعلمات) وهو متواجد حالياً بالسلطنة لجمع المعلومات اللازمة لبحثه .

نرجو التكرم مساعدة المذكور في الحصول على المعلومات والبيانات المطلوبة قدر الإمكان .

شاكرين ومقدرين كل جهد ومساعدة تقدم للمذكور لتسهيل مهمته .

سعيده بنت عبدالله الصبحي

٣١٤  
٢٠٠٠

مدير الدراسات العليا





ك م ع / ٥ / ١٨٦٩ / ١

١٦ / ٩ / ٢٠٠٠

المحترمين

الأفاضل / عمداء كليات التربية

السلام عليكم ورحمة الله وبركاته... وبعد

الموضوع / الفاضل عبدالله بن سيف التوبي طالب الدكتوراة

- أرجو تسهيل مهمة طالب الدكتوراة الفاضل / عبدالله بن سيف التوبي وذلك في الجوانب التالية :
- تطبيق الاستبيان الخاص ببحثه على أعضاء هيئة التدريس / قسم الدراسات التربوية .
  - إجراء مقابلة مع بعض أعضاء هيئة التدريس في القسم .
  - تطبيق إستبيان على طلبة السنة الرابعة / تخصص علوم .
  - إجراء مقابلة مع بعض طلبة السنة الرابعة / تخصص علوم .

لبنين محرم

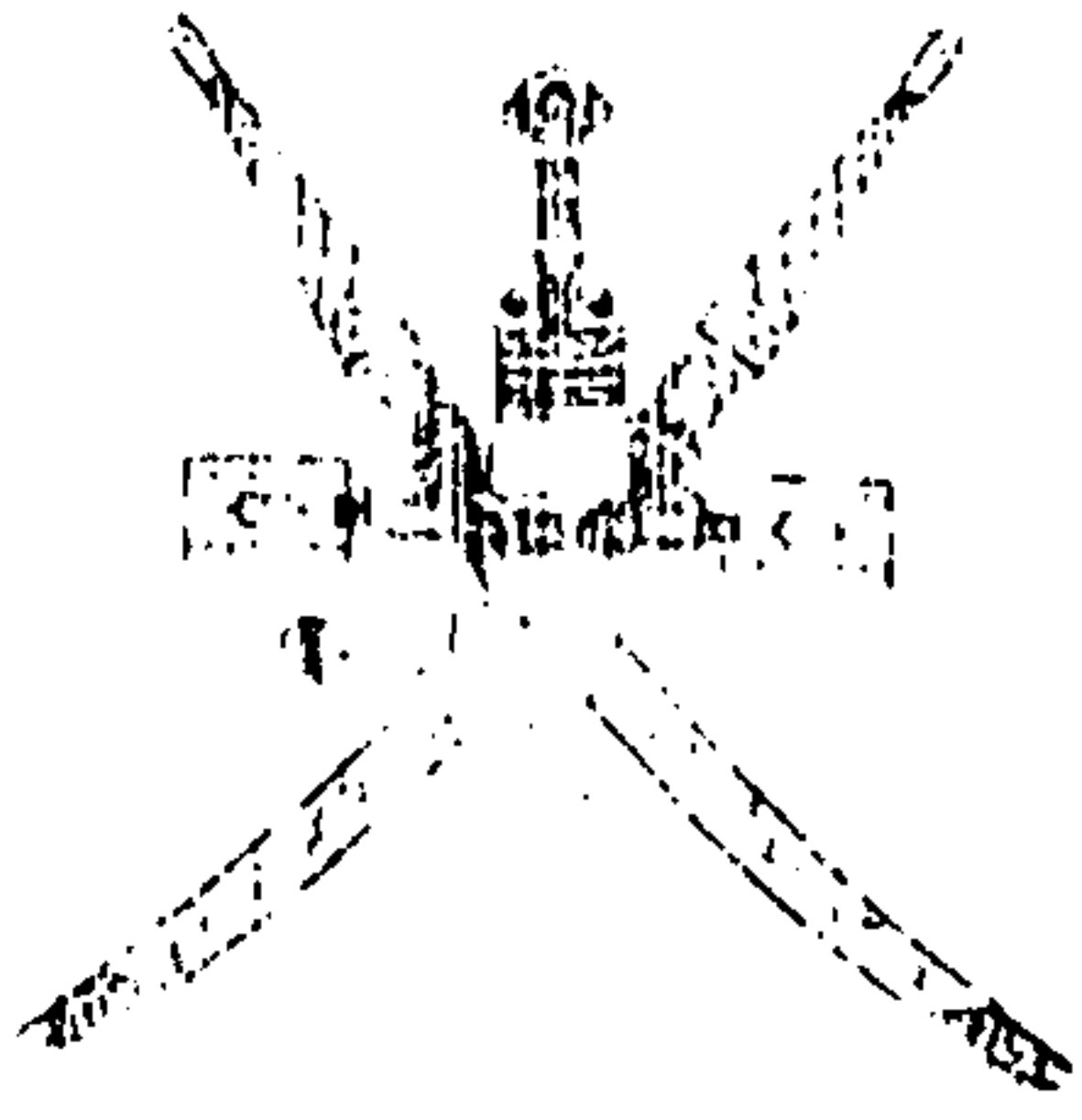
د. محمد بن سليمان البندري

مدير عام كليات التربية

وتفضلوا بقبول فائق الاحترام

لسخة الى :

- رئيس مكتب معالي الوزير
- مدير مكتب معالي الشيخ الوكيل
- مدير دائرة الدراسات العليا
- مدير دائرة المناهج
- الملف



سَيِّدَةُ الْبَيْتِ  
وَزَارَةُ التَّرْبِيَّةِ وَالتَّعْلِيمِ  
الْمَدِيرِيَّةُ الْعَامَّةُ لِلتَّرْبِيَّةِ وَالتَّعْلِيمِ  
لِلْمَنْطِقَةِ الدَّرْعِيَّةِ

مكتب متابعة وتقييم الاداء المدرسي

الرقم : م : ع : ت : د : ١ / ١٤ / ٢٠٠٨  
التاريخ : ١٩ / ٦ / ١٤٢٧ هـ  
الموافق : ١٨ / ٩ / ٢٠٠٨ م

الإفاضل / مدير في ومديرات مدارس ولاية ازكي الملتزمين

السلام عليكم ورحمة الله وبركاته ... وبعد ...

يرجى السماح للفاضل / عبدالله بن سيف بن محمد التوبي الدارس  
بجامعة ويرك لإجراء المقابلات اللازمة مع معلمي ومعلمات مادة العلوم من  
خريجي كليات التربية بغرض استكمال اجراءات الدراسة وتزويده  
بالمعلومات اللازمة .

وتفضلوا بقبول فائق الاحترام ...

لسعود بن لسالم بن ناصر العزوي  
المدير العام

الفاضل محمود حلم المدرس الأول

نسخة الى  
= مكتب متابعة وتقييم الاداء المدرسي  
= الملف