# A Socio-Cultural Investigation of Science Curriculum Reform and Implementation in Kuwait: Perspectives of Teachers, Students and Curriculum Reformers

**by**

**Ahmad Shallal Alshammari**

**A thesis submitted to**
The University of Exeter as a thesis towards the degree
of Doctor of Philosophy in Education

**May 2014**



I certify in the year of submission that all material in this thesis which is not my own work has been identified and that no material is included for which a degree has previously been conferred upon me.

(Signature of the candidate)……………………………………

# Abstract

In 2008 the Ministry of Education in Kuwait began to reform the science curriculum in schools at all academic stages: primary (grades 1-5), intermediate (6-9) and secondary (10-12). The new science curriculum was adapted from an original curriculum which had been designed and published by the Amercan company Pearson-Scott Foreman. This study explores the perspectives of science teachers and students concerning the new science curriculum for the sixth and seventh grades (students aged 11 to 15) in the State of Kuwait. The study also investigated the process of the reform and the roles that science teachers and students performed in this reform process. The study used Sociocultural Theory as a framework to examine the science curriculum reform process and to discuss findings.

A multi-method design was used with both quantitative and qualitative methods to collect the data: science teachers' and students' questionnaires; interviews with science teachers, students and science curriculum reformers; and classroom observations. The study sample was selected randomly. The questionnaire was conducted with 310 science teachers and 647 students. 11 science teachers, nine reformers and 30 students (five in each of six focus groups) were chosen to conduct in-depth interviews. Ten classroom observations were conducted with four science teachers.

The study indicated that the science curriculum reform process was controlled centrally by the Ministry of Education and teachers and students did not participate in any stage of the reform process. The findings also found that many of the science teachers and students held negative views about the new science curriculum. They felt that the content of the new curriculum does not relate very well to Kuwaiti culture, to the Islamic religion and that the curriculum objectives needed to be more clear and achievable. The findings showed that many of the students indicated that they have difficulty understanding much of the content and did not enjoy studying science. Most of the teachers indicated that they faced challenges in teaching the new science curriculum. These included a lack of instructional tools, lack of teacher autonomy, the amount of material that needed covering and large class sizes.

This study recommends reviewing the new science curriculum (now currently in use) taking into account the perspectives of teachers and students. It recommends that in carrying out curriculum reform the Ministry of Education be encouraged to provide guidance in the form of instructional tools and professional development programmes for teachers. These should be designed to help teachers develop the pedagogic skills needed to address the complex relationships between science and culture and between science and religion.

# Dedication

To my big family (my father, my mother, my brothers and sisters)

To my small family (my wife, my sons and daughter)

To the spirits of the father and mother of my wife

To my supervisors Nigel and Nasser

To my tutors, teachers and colleagues

# Acknowledgements

First and foremost and forever I want to thank my God (Allah) who has provided me with health, strength and the ability to complete this project. Without His mercy, grace and guidance this work would have not been accomplished.

Very big thanks to my mother and father who have always prayed for me and supported me from the first day of my trip to complete my postgraduate study in the UK. Special thanks should go to my family: my wife, and my children, Basmah, Abdulrahman, Faisal and Shallal, along with my wonderful brothers and sisters who encouraged me by their moral support, love and by sharing my dream. Without my great family, this project would not have been achieved.

I will not forget to send special thanks to the spirits of the father and mother of my wife who encouraged me to achieve my dream to get the PhD. I wish they were with me in this special moment they were waiting for.

My deep appreciation and gratitude goes to my first supervisor Dr Nigel Skinner for his constructive feedback, support, guidance, encouragement and supervision. I have learned a lot of things from you throughout the project which will contribute to my personal development in the future. Thank you very much Nigel for everything.

I am indebted to my second supervisor Dr Nasser Mansour who served as my brother and was very keen to support me at each stage of the project. From the bottom of my heart I would like to thank you very much Nasser for your invaluable comments and constructive feedback, support and guidance throughout the project. Thank you for your moral support, and encouragement to complete this project successfully.

My gratitude goes to the University of Exeter represented in its administration and staff for providing an ideal environment for learning and research.

Last but not least, I would like to thank my colleagues, friends and all the participants who granted me their valuable time to take part in the study.

# Table of Contents

| Content | Page |
|---|---|

## Chapter Three: Review of the Literature

## Chapter Four: Research Design and Methodology

## Chapter Five: Quantitative Findings

## Chapter Six: Qualitative Findings

## Chapter Seven: Discussion of the Research Findings



## Chapter Eight: Limitation, Implications, and Suggestions for Future Studies

# List of Tables

# List of Figures

# List of Appendices

# Abbreviations

| | |
|---|---|
| **CLT** | Central Limit Theorem |
| **ESPK** | Education Strategy Project for Kuwait |
| **GCC** | Gulf Cooperation Council |
| **MoE** | Ministry of Education |
| **PAAET** | Public Authority for Applied Education and Training |
| **PISA** | Programmme for International Student Assessment |
| **SCT** | Social-Culture Theory |
| **TIMSS** | Trends in International Mathematics and Science Study |

# Chapter 1
# Introduction

## 1.1 Introduction

The curriculum is considered to be one of the most important areas of the educational system. An appropriate curriculum is considered crucial to the success of the educational process and the achievement of the goals of education. Toombs and Tierney (1993) argue that the 'curriculum lies at the heart of education' (p.186).

The process of reforming and developing the curriculum is also critical. To maintain its relevance, the curriculum should be continuously reformed so as to keep pace with the scientific, technological, economic and social developments in the world. This is particularly important for the science curriculum because new scientific discoveries are leading to the rapid development of our understanding of the natural world.

The significance of science curriculum reform is argued in a recent study by Ryder (2014), who indicates that there 'have been and continue to be, persistent attempts to change the school science curriculum' (p.2). Ryder finds that this constant change and reform are inevitable outcomes of the continued change and development in education policy, science, technology and society, adding, 'Such curriculum reforms have a significant impact on the work of teachers and the classroom experiences of students' (p.2). According to another recent study by Al-Ghamdi & Al-Salouli (2013) of the science curriculum reform in the Kingdom of Saudi Arabia, the need to reform the science curriculum is of worldwide concern.

Hence, in recent years many countries have started to develop and reform their science curriculum (Ha et al, 2008), for example, many of the Gulf Arab states, including Kuwait, Saudi Arabia, the United Arab Emirates (UAE) and Bahrain (Dagher and BouJaoude 2011).

In many Gulf Arab states the science curriculum has been reformed by adopting and adapting a science curriculum designed for use in a Western country, which is different in social and cultural ways from any Arab country. In Kuwait, the Ministry of Education (MoE) has adopted a science curriculum designed and published by the

USA Company Pearson-Scott Foreman (Al-Barak, 2011). The UAE have adopted a science curricula series published by Harcourt, another American publisher (Alqasemy, 2013) and in Bahrain and Saudi Arabia, the science curricula published by McGraw-Hill (also a US company) have been adopted (Dagher and Boujaoude, 2011; Obeikan Education, 2012).

However, the social and cultural differences must be taken into account when adapting a Western science curriculum, so as to ensure that it is relevant to the socio-cultural and religious background of the students and teachers (Al-Daami and Wallace, 2007; Fullan, 2007; Idris et al., 2012; Khan, 2010; Mansour,2013; Reiss, 2010; Shah, 2012; and Van den Akker, 2003). In this respect, Barab and Luehmann (2003) indicate that a central challenge for science curriculum developers is finding how to adapt the science curriculum to meet the culture, needs and goals of their local context.

The last few decades have seen an increased interest in the socio-cultural perspectives within science education and science curriculum reform (Lemke, 2001). According to BouJaoude and Gholam (2013) ‘‘The socio-cultural perspectives in science education emerged as important research areas which should be taken into account while designing curricula, teaching concepts and developing views about students’ understandings’’ (p.340).

The significance of relating what the student learns in the classroom with socio-cultural and daily life are discussed in Social Culture Theory (SCT), which argues that learning is social and mediated by cultural objects (Vygotsky, 1987). According to Scott & Palinscar (2009),

> *The work of sociocultural theory is to explain how individual mental functioning is related to the cultural, institutional and historical context; hence, the focus of the sociocultural perspective is on the roles that participation in social interactions and culturally organised activities play in influencing psychological development (p. 1).*

The SCT holds that the everyday ideas of the student are the basis of his understanding, development and acquisition of the scientific ideas which are learned through the curriculum (Bliss, 1995). The SCT is used in this study as the theoretical framework in which the science curriculum reform process should be understood (see section 3.4.1).

The science curriculum reform has recently been an important issue in Kuwait. The reform process included the science curriculum at all the stages of education (primary, intermediate and secondary); it was introduced in the 1st and 2nd grades in 2008, in the 3rd, 4th and 5th grades in 2009, in the 6th and 7$^{th}$ grades in 2010, in the 8th grade in 2012 and in the 9th grade in 2013. The present study is focused on the new science curriculum of the sixth and seventh grades (the intermediate stage).

The Ministry of Education (MoE) entrusted the process of science curriculum reform to a group of its decision makers. This is confirmed by Mr Al-Wetaid (Assistant Under-secretary for the curriculum sector in this MoE) who said that the group consisted of the Minster of Education, Assistant Under-secretary for the curriculum sector, some science inspectors and some staff from the curriculum sector (Al-Wetaid, 2011).

This confirms and draws attention to the fact that the teachers and students did not participate in the reform process of the science curriculum. In this respect, Ryder (2014) advocates the central role of teachers in science curriculum reform and discusses the adverse effects of excluding them from the reform process. One of these negative effects is probably the failure to obtain the intended outcomes of such reform ‘‘The science curriculum undergoes repeated reform in many countries. However, it tends to be reported that the enactment of such reforms within schools rarely reflects the intended outcomes of curriculum designers.’’ (p.1) Ryder concludes that the science teachers who did not proactively choose to adopt a curriculum reform faced some tensions and dilemmas in teaching it and thus the reform as intended by its developers never emerged. This was the result of their belief that this curriculum reform might run counter to their own professional beliefs and goals (Ryder, 2014).

The importance of giving students a role in the science curriculum reform is discussed in many studies, such as that by Cerini, Murray and Reiss (2003), which concluded with the comment that to listen to students in reform process is essential. If their needs and preferences in studying science are disregarded, they will not learn easily, because it should be related to their everyday lives. Levin adds (2000) that ‘‘education reform cannot succeed and should not proceed without much more direct involvement of the student in all its aspects’’ (p. 155).

The present study aims to explore in detail the process of science curriculum reform in Kuwait, seeking the views not only of the science curriculum reformers, but also of the science teachers and their students. It uses a framework based on socio-cultural theory to identify the positive and negative aspects of the reform process and the impact that the reform has had on the teaching and learning of science.

### 1.2 Research problems

The culture of American society is quite different from that of Kuwaiti society. Many studies (e.g. Al-Daami and Wallace, 2007; Fullan, 2007; Idris et al., 2012; Khan, 2010; Mansour,2013; Reiss, 2010; Shah, 2012; &Van den Akker, 2003) indicate that the science curriculum should be made relevant to the socio-cultural situation in which it is taught. Vygotsky (1987) asserted that it is important to link learning in school with the students’ daily life and culture, yet the current science curriculum of Kuwaiti schools was designed in and for the USA by an American company. The current study investigates the relationship between the new science curriculum and the Islamic religious culture of Kuwaiti society.

The Kuwaiti Teachers’ Society focused on the centralised control of the curriculum and the Society’s 33rd conference in 2004 was entitled ‘Let’s Listen to Teachers’ Voices’. This was a significant event held under the auspices of H.H. the Crown Prince of Kuwait and in the presence of the Minister of Education. Among the recommendations emerging from this conference were the call to pay more attention to teachers’ views and to re-organise teachers’ training and preparation programmes because they were considered to be inadequate (Al-Hamad, 2004). The conference concluded with several recommendations, including teachers’ involvement in establishing educational policies and plans and in making educational decisions.

Al-Shatti (2012) also criticised the centralised working of the MoE and the changes that are made in the curricula without engaging stakeholders, such as teachers and specialists from different backgrounds. Dagher & BouJaoude (2011) also argue that science curriculum reform in many Arab states is centrally controlled by ministries of education and is rarely an outcome of democratic negotiation between the various stakeholders.

This study will explore the teachers' and students' views on the new science curriculum and the difficulties facing them in working with it, together with their recommendations for its development.

Another problem concerns the implementation of the new science curriculum. The MoE imposed the new science curriculum without piloting (Al-Barak, 2011) it, despite studies which show that piloting a new curriculum is critical in identifying weaknesses and detecting issues and errors which would otherwise be unnoticed. Piloting would also have allowed teachers to familiarise themselves with the curriculum content (Corbett et al., 2013).

Science teachers whom I met when preparing the proposal for this study complained that the new science curriculum had been introduced without any training course being provided for them. They indicated that the MoE required the new curriculum to be taught straightaway, despite its significant differences in content from its predecessor.

I experienced the same problem when I was a science teacher of intermediate students in Kuwait. After graduating from the College of Basic Education, I was immediately asked to teach the science curriculum without any training. I felt that the MoE was not interested in providing training courses to develop teachers' skills. In this study I will explore the effects on teachers and students of this failure to pilot a new curriculum or to provide training courses for it.

To sum up, the research seeks to investigate the issues arising from the following factors:

- The new science curriculum was designed in the USA, which has a different socio-cultural environment and religious situation from Kuwait.

- Science teachers and students did not participate in the process of reforming the science curriculum.
- The new science curriculum was introduced without piloting it and without providing any training courses for science teachers.

## 1.3 Research aims

The study aims to comprehensively explore the details of the reform process of the science curriculum, the reasons for the reform, the phases of the reform process and the role of the individuals who were given responsibility for it. It also explores the views about and attitudes to the new science curriculum in grades six and seven in the schools of Kuwait among science teachers and students. The particular focus is on the relationship of the new curriculum to the culture, needs and Islamic religion of the students. The study also aims to explore details of the teaching and learning of the new science curriculum teaching and explore the difficulties which teachers and students encountered.

## 1.4 Significance of the research

According to a recent study by Al-Ghamdi & Al-Salouli (2013) about the science curriculum reform in the Kingdom of Saudi Arabia,; ''Much has been reported about the first tier of reforms in North America, Europe and Australia, but less is known about the second tier of reforms in African, Asian, Eastern European and Middle Eastern countries'' (p.501). Hitherto, there has been no study in Kuwait relating to the process of reforming the current science curriculum, so part of the importance of the present study lies in the fact that it is the first of its kind.

According to Shaw (2006), the education policy makers in the Arab states are not interested in involving teachers and students in the process of education reform. Hence, another reason that this study is important is that it listens to the views of a range of people who are not usually consulted.

This study is also important because it examines the reform process from many different aspects, including the curriculum content, its objectives, teaching methods, instructional tools and assessment system.

Questionnaires, interviews and classroom observations have been used to collect data in order to improve the credibility of the results. I hope that the study will serve as a future source of reference for the decision-makers in the Ministry of Education in Kuwait when developing and reforming curricula.

### 1.5 Reasons for undertaking this research

The subject of my study was selected for several reasons. I am interested in this particular stage of schooling, because I graduated in 2003 from the Basic College of Education in Kuwait as a science major and worked for four years as a teacher of science in the intermediate stage (from the sixth grade to the ninth). During this time I became aware of the concerns of teachers and students with respect to the science curriculum and identified some of their needs.

I also found from experience that the MoE was not interested in involving teachers and students in the process of curriculum reform and development, despite the importance of considering their views. The natural tendency of the MoE's work was for it to be centralised; all the decisions relating to the education system were made by policy makers in the MoE. For this reason I wanted to bring in the voice of the science teachers and students and learn what they thought of the new science curriculum.

I chose to concentrate on the sixth and seventh grades, partly because I had taught students in these grades and partly because when the data for this study were collected, the new curriculum had been taught at the intermediate stage in these grades only. The next two grades (eighth and ninth) were still studying the old science curriculum.

In 2007 I was awarded a scholarship by Kuwait's Department of Curriculum in the Public Authority for Applied Education and Training (PAAET) to take up postgraduate studies about the science curriculum. After my doctoral degree is awarded, I intend to go back to Kuwait to work as an assistant professor in the Department of Curriculum and my teaching and research interests will remain in the curriculum area.

## 1.6 Structure of the Thesis

This study is divided into eight chapters. The following is a brief summary of their content.

**Chapter One** presents an introduction to this study including the importance, aims, significance of and reasons for the study.

**Chapter Two** clarifies the study context by presenting the education and science education background to the State of Kuwait. In addition, this chapter discusses the process of science curriculum reform in Kuwait.

**Chapter Three** reviews the literature related to the science curriculum reform. It includes a discussion of what is meant by the term 'curriculum' and studies of curriculum reform in a variety of different contexts. Socio-cultural theory is introduced as the theoretical framework for the study and science curriculum reform in relation to the socio-cultural context is discussed.

**Chapter Four** describes the research design and methods of this study. It begins by outlining the research paradigm adopted, together with its ontological and epistemological assumptions. This chapter also includes the methods of data collection and analysis. Research ethics and research samples are also discussed in some detail.

**Chapter Five** presents the quantitative study findings based on the responses of science teachers and students to the questionnaires. The data are analysed in this chapter using the Statistical Package for the Social Sciences (SPSS)

**Chapter Six** contains the qualitative findings from the interviews with science teachers, students and curriculum reformers. Classroom observations are also presented, together with the results of a data analysis, using a thematic coding method.

**Chapter Seven** discusses the quantitative and qualitative findings of the study in light of the literature review and research questions.

**Chapter Eight** considers the limitations of the research and goes on to offer some conclusions about the main findings and their significance. The chapter presents the implications of the study and offers some suggestions for future research.

## 1.7 Summary of the chapter

In this chapter, an introduction to the study was given, together with the research problem, research aims, significance of the research, reasons for carrying it out and the structure of the thesis. The next chapter discusses the research context, which is the State of Kuwait.

# Chapter 2

# Background and the Context of Research

## 2.1 Introduction

When we come to discuss any reformation and development of a nation’s education, whether in the curriculum or the system, it is better to first learn about the nature of the society, with its culture, religion and history, in which such change is to take place. The purpose of this chapter is to give a general background to the current research context.

The first part of this chapter gives an outline of the history of Kuwait and an overview of the education system, and the state of science education in Kuwait including science teaching, professional development programmes and the way in which students are assessed.

The second part of the chapter discusses the reform process of the science curriculum in Kuwait in all its phases, and finishes by assessing the importing of a Western science curriculum to be taught in Arabic states.

## 2.2 Background of the State of Kuwait

Kuwait is a small country, with an area of 17,818 sq km. It is located in Asia at the north-western shore of the Arabian Gulf, bordered by the Republic of Iraq to the north and north-west and by the Kingdom of Saudi Arabia to the south and south-west. To the east it is bordered by the Arabian Gulf (Sultan & Fyath, 1993). The religion of Kuwait is Islam and the official language is Arabic (Constitution of Kuwait, 1962). Economically, Kuwait is one of the world’s most important producers and exporters of oil, is a founding member of OPEC, and has the world’s fifth largest oil reserves, which account for 80% of government revenues (Ministry of Planning. 2012).


**Figure 2.1** State of Kuwait Map (Adapted from world Atlas)

On 19th June 1961, during the reign of Sheikh Abdullah Al-Salem, the protection convention with Britain was cancelled and the country's independence was recognised (Al-Khatrash, 1984). Following independence, political life began to develop in a well-organised way. The first assembly formed to manage the affairs of the country was elected by the people. In November 1962, the Kuwaiti constitution, which still holds, was issued to regulate the political systems and laws (ibid.) The state of Kuwait is an hereditary emirate and follows a democratic system, with laws enacted through its parliament, which is elected by the people every four years and is composed of 50 members (Constitution of Kuwait 1962). It is administratively divided into districts, organised into six governorates: the Capital, Jahra, Farwaniya, Hawalli, Mubarak Al-Kabeer and Al-Ahmedi (Kuwait Government Online, 2013). In 1990, during the reign of Sheikh Jaber Al-Sabah, the Republic of Iraq completely occupied the State of Kuwait, resulting in a comprehensive destruction of oil wells, key buildings, hospitals and factories, etc., bringing life to a complete standstill, with predictable economic consequences (Al-Yousfy, 2000). On 26th February 1991, Kuwait was liberated with the assistance of a group of other countries and returned to the rule of the Al-Sabah Family (ibid). Kuwait once more showed signs of life and resumed its production of oil. However, this took a long time amid the destruction and ruin of almost every organised concern. According to the report which was published by the Public Authority for Civil Information (PACI), in 2012 the population of Kuwait was 3,484,880, of whom 1,118,911 were Kuwaiti citizens, the rest being foreign workers. The growth rate of the population was 6.5% p.a., considered one of the world's highest.

### 2.3 Educational System in Kuwait

The educational system in Kuwait is free for all Kuwaiti citizens and compulsory from grade one in the primary stage until stage nine which is the final grade in intermediate stage (Education Statistical Group, 2012). The education system in Kuwait is divided into a kindergarten stage of 2 years (not compulsory), a primary stage lasting 6 years (compulsory), intermediate stage 4 years (compulsory) and a secondary stage of 3 years ( not compulsory) (ibid).

#### 2.3.1 Kindergarten Stage (Age range 4 - 6)

The first kindergarten was established in 1955 (Al-Abdulghafoor, 1983). Children spend two years there, from the age of four. Kindergarten is the only stage where boys and girls are taught in the same classroom; the teaching and the management staff are all women. This stage is intended to develop the child's personality and prepares them to move on to formal education (ibid). The number of kindergartens in Kuwait, according to the government statistics for the school year 2012/2013, was 195 and the number of pupils was 41,811 (Education Statistical Group, 2012).

#### 2.3.2 Primary Stage (Age range 6 - 11)

The primary stage is the beginning of compulsory formal education in Kuwait. The primary stage is divided into five academic grades, from one to five. The subjects taken are Islamic studies, the Arabic language, English, mathematics, science and geography. It is worth noting that the English language began to be taught at this stage in 1995. Before this, English was taught only from the intermediary stage onwards. The number of primary schools and students, according to the Education Statistical Group for 2012, was as follows (see Table (2.1)):

**Table 2.1:** The number of primary schools and students in Kuwait

| | Male | Female | Total |
|---|---|---|---|
| **Schools** | 126 | 123 | **249** |
| **Students** | 63091 | 66604 | **129695** |

### 2.3.3 Intermediate Stage (Age range 11 - 15)

The intermediate stage is divided into four academic grades, numbered six to nine. This stage occupies the child from the age of 11 to 15, after which education is no longer compulsory. The school subjects taught in this stage are the same as in the primary stage. This study was carried out on the grades six and seven in the intermediate stage. The number of intermediate schools and students, according to the Education Statistical Group, 2012, is shown in Table (2.2):

**Table 2.2:** The number of  intermediate schools and students in Kuwait

| | Male | Female | Total |
|---|---|---|---|
| **Schools** | 96 | 103 | **199** |
| **Students** | 54220 | 55935 | **110155** |

### 2.3.4 Secondary Stage (Age range 15 - 17)

The secondary stage is the last for Kuwaiti students and extends for 3 years, from the age of 15. The secondary stage is divided into three, numbered ten to twelve. In the last two years of it, students choose in advance whether to take scientific or literary majors. The students in the scientific section are taught biology, geology, chemistry and physics, in addition to such basic subjects as the Arabic language, Islamic studies, the English language and mathematics, which are offered in the literary section also. The students in the literary section are taught psychology, philosophy, geography and history. The number of secondary schools and students in Kuwait, according to the Education Statistical Group, 2012, was as follows Table (2.3):

**Table 2.3:** The number of secondary schools and students in Kuwait

| | Male | Female | Total |
|---|---|---|---|
| **Schools** | 62 | 68 | **130** |
| **Students** | 27043 | 35078 | **62121** |

## 2.4 Science education in Kuwaiti schools

This study is focused the reform of the science curriculum at the intermediate stage in Kuwait. This section presents details of the science education at present in Kuwait. According to the handbook of the Education in Kuwait (2012), science subjects are compulsory for all students' at all primary and intermediate stages from the first grade to the ninth. At the secondary stage only the students who have chosen the scientific major will study the science subject, divided into four subjects: physics, chemistry, biology and geology, and the students who have chosen the literary major don't study science. According to the handbook of the Education in Kuwait (2012), at the three stages of education, science is presented as follows**:**

- **Primary stage:** In this stage, science as a general subject is taught in all grades at the rate of three weekly classes, each lasting 45 minutes.
- **Intermediate stage:** In this stage, science as a general subject is taught in all grades at the rate of four weekly classes, each lasting 45 minutes.
- **Secondary stage:** In this stage, four branches of science – physics, chemistry, biology and geology – are taught. These subjects are taught at the rate of two weekly classes, each lasting 45 minutes.

### 2.4.1 Science education objectives

The MoE has set general objectives for science subjects overall for all education stages, which it states as follows (Science teacher guide book, 2012):

- Help learners nurture the Islamic creed in their souls, consolidate faith in God and develop positive trends towards Islam and its values.
- Help learners to acquire scientific facts and concepts.
- Help learners to acquire the appropriate predispositions.
- Help learners to acquire and develop the appropriate intellectual skills.
- Help learners to acquire the appropriate scientific skills.
- Help learners appreciate scientists' efforts and their role in the development of human knowledge.

These general objectives for teaching science have to be attained by the science curriculum in all stages of education. Of these objectives the first relates to the Islamic religion. One of the focal points of the present study is the relationship between science and Islamic culture. According to the Science teacher guide book (2012) the general basis of the science objectives in Kuwait can be defined as follows:

- **Social basis:** this means the basis related to the nature of Kuwaiti society, its philosophy, circumstances and principles and the social changes undergone by this society, whether local, regional or international.
- **Psychological basis**: this means the basis created by the nature of the learner and his needs, abilities, tendencies and readiness.
- **Educational basis**: one of the most important criteria in setting the science objectives in Kuwait is its dependence upon the educational philosophy of Kuwaiti society, which includes a comprehensive view of the concerns, lives and nature of the people who form the principles of society and its Islamic and Arab values.

### 2.4.2 Science objectives in the Intermediary Stage

The MoE in Kuwait has provided science objectives for each education stage. Since this study is concerned with the intermediate stage, it lists here only the science objectives of the intermediate stage according to the science teachers' guide book (2012):

1. **Help students to deepen their Islamic faith; strengthen faith in God in their hearts and develop positive attitudes towards Islamic values**.

   This can be done by estimating Allah's (God) Greatness in his creation of the universe and the creation and organisation of living creatures; and by reflecting on the beauty of nature and its components.

2. **Help students link the facts with scientific concepts in their everyday life**.

   What students learn should be linked with their everyday life so that they are able to use science to solve everyday problems, improve their standard of living and understand the environment in which they live.

3. **Help students gain and develop appropriate attitudes, values and habits.**

   Examples of these are good health habits, scientific integrity, respect for the opinions of others, respect for manual work and not making over-hasty judgments.

4. **Help students gain and develop appropriate mental skills.**

   This includes the development of scientific thinking; the ability to identify problems; gathering, analysing and interpreting information about them; making assumptions; testing the authenticity of these assumptions, and then finding solutions to the problems. Mental skills also include observation, measurement, classification, interpretation, reasoning, induction and deduction.

5. **Help students gain scientific practical skills.**

   Examples of these are skills in the use of scientific tools in scientific experiments and the maintenance of these devices; skills in making simple scientific tools; methods of measurement and weight; simple anatomy and drawing.

6. **Help students gain appropriate scientific interests and tendencies**

   Knowing the direction of their tendencies helps students to understand themselves and give them self-confidence. The areas which would help a student explore their interest and the trends in science subjects include scientific reading, curiosity, experimentation, manual work, sample collection and testing, and making simple scientific instruments and equipment.

7. **Help students appreciate science and the efforts of scientists, together with their role in the advancement of science and humanity.**

8. **Help students recognise the scientific achievements of Arab and Muslim scientists and respect and appreciate them**.

   In addition to the students' knowledge of scientific achievements in general, focus should be also placed on the efforts of Arab and Muslim scientists who have made significant contributions to humanity, such as Jaber Ibn Hayyan, Al-Khwarizmi, Ibn Sina and many others. This is to encourage and motivate students to continue the current progress in research, development and discovery in various scientific fields.

From the above description of the science objectives in the intermediate stage, it is clear that some links exist between science and the Islamic religion and social culture. Since the current study is interested in this point, it will be followed up in the literature review and discussed among the findings of the study in the discussion chapter.

## 2.5 Science teachers in Kuwait

According to the Education Statistical Group, 2012, the numbers of science teachers in all stages of Kuwaiti schools are distributed as shown in Table (2.4). From Table (2.4) below it is clear that the female science teachers outnumber the males, in particular in the primary stage, because most of the primary schools for boys are taught by female teachers. In this study I focus on the science teachers (male and female) who teach the sixth and seventh grades in the intermediate stage. According to the Education Statistical Group, 2012, the Ministry of Education in Kuwait is responsible for choosing and employing all the science teachers in its schools. The main condition of the Ministry of Education for a teaching post is having a bachelor's degree or higher in science education or a specialism of science, such as physics, chemistry, biology or geology.

**Table 2.4:** The science teachers in Kuwaiti schools

| School stage | | Male | Female | Total |
|---|---|---|---|---|
| **Primary stage** | | 148 | 984 | **1132** |
| **Intermediate stage** | | 764 | 872 | **1636** |
| | **Chemistry** | 260 | 320 | **580** |
| **Secondary stage** | **Physics** | 272 | 300 | **572** |
| | **Biology** | 221 | 312 | **533** |
| | **Geology** | 97 | 145 | **242** |

According to the Handbook of the Education in Kuwait, 2012, in Kuwait there are just two institutions which prepare and train pre-service science teachers: Kuwait University and the Basic Education College. The duration of this teacher education programme is four years, of which they have to study 130 hours to graduate and be a science teacher. The Pre-service science teachers go for teaching practice experience in local schools as part of their teacher education programme. The duration of teaching practice experience is one term (approximately 17 weeks).

### 2.5.1 Science teacher autonomy in Kuwaiti schools

The autonomy of science teachers has been debated in some studies, but before surveying them I want to describe this autonomy as I experienced it, when teaching the subject to intermediate students from 2003 until 2007. At the beginning of every school year the MoE sent the science teaching plan (see section 2.5.2 below) which included the curriculum content that I had to teach and the time allocated to teaching it. My role was to follow this plan in every detail. In addition, the students' assessment and their exams were designed by the MoE and I had merely to implement them. I can only conclude that the MoE runs a centralised system and the teacher's role is limited – simply to teach the science curriculum.

One of the studies that discusses teacher autonomy in Kuwait is by Al-hajeri (2007). He concludes that the role of the teacher in the Kuwaiti school is limited to following the MoE's rules, such as its teaching plan, without any change or development and he infers that the lack of freedom in teaching impacts negatively on the creativeness of the teaching process and the students' attitude to learning, because they feel that most classes are boring. These conclusions of Alhajeri's study are confirmed by that of Al-Enezy (2008) on the same topic: he writes that the constraints on teachers negatively affect their attitude to their vocation and hamper their creativity. In addition, he mentions the impact that this has on the teacher's objective, which changes to merely teaching students to pass the exams. He calls for greater freedom for teachers in this area.

In addition to the lack of teacher autonomy in Kuwait, some studies describe the heavy workload for the teacher, which also has a negative impact on the profession and the teaching process. This problem is not new in Kuwait, however; many studies have focused on this feature, such as Salem's study (2000) of the role of the science teacher in Kuwaiti schools of all stages. He indicates that these teachers are given additional work not related to the teacher's role, such as taking payments in the school canteen and observing the students at break times. Salem adds that these additional tasks hamper the creativity of the teaching process. Ismail, (2003) in his study of the education system in Kuwait agrees; he confirms that the MoE gives teachers extra administrative work which wastes their time and is of no benefit to them. Ismail and Salem recommend that teachers should not be assigned any administrative work which is unrelated to the teaching process because they are already heavily burdened and it puts the teaching process at risk. In another study by Dagher & BouJaoude (2011) of the science education in Arab states including Kuwait, they agree that these teachers have added administrative work unrelated to their teaching tasks, which wastes their time and negatively affects their teaching skills and students' progress in the classroom.

The importance of teacher autonomy is recommended in many studies, as having a positive impact on education. According to Davis (2003), teachers, and to a lesser extent students also, benefit from having some autonomy in the classroom. This is because interactive and discovery-based types of learning are more enjoyable and ultimately more memorable than the close adherence to a very rigid curriculum. A teacher who is free to follow up particular student questions and interests will find his audience more receptive to new ideas, because they will appear more directly relevant to the local context. It is recognised that authentic teaching is not just a unidirectional channelling of finite pieces of information from teacher to pupils, but at its best consists of the active construction of meanings in collaboration between children and their teachers (Martin et al., 1990). Such an approach encourages the fundamental scientific ability to engage in open enquiry and this is now being recognised as a priority for implementation across many countries (Abd-El-Khalick et al., 2004).

There is little point in having a regional or national reform of science education to meet particular abstract objectives if the students and teachers in the classroom are being constrained and impeded in their natural desire to use innovative and exciting ways to teach and learn. It is a common complaint in many countries that teachers spend many years training to use a range of skills and bring impressive talents to their job, but rigid curricula and dull materials prevent them from using what they know will work. One empirical study in the United States describes a regime of moderate state and regional control over curriculum content and textbooks, but at the same time says that ‘‘teachers [reported] almost complete control over pedagogy in the classroom (teaching techniques, achievement standards and assignments)’’ (Archbald & Porter, 1994, p. 35). This appears to give a good balance between assuring continuity across a large number of schools, and final achievement outcomes, while encouraging teachers to use their skills to make the content suit their particular cohorts of children in terms of methods, pace and interim testing modes.

Another important reason for allowing teachers autonomy in their teaching is that this extends the robustness and capability of the whole education sector, in particular when professional teachers can meet to discuss their own practice. Local variation around a common core curriculum encourages the improvement of out-dated methods. In training courses and conferences teachers can synthesise the best of their ideas and help to produce an education sector that leads the world, rather than following several steps behind current practice elsewhere (Shymansky & Kyle, 1992). According to Sahlberg (2006) the world desperately needs to wake up to the economic and social challenges of globalisation, and the education sector has a hugely important role in preparing nations to do this. His conclusion is that ‘‘The key features of education reform policies that are compatible with competitiveness are those that encourage flexibility in education systems, creativity in schools and risk-taking without fear on the part of individuals’’ (Sahlberg, 2006, p. 259). Teacher autonomy is the first and most important step towards this goal and so long as it is implemented in culturally appropriate ways it can transform the impact of education in much needed directions for the future.

From the previous argument the importance of teacher autonomy in the teaching process is clear: giving freedom for the teacher to teach as they deem appropriate for their students will provide an opportunity for creativity in teaching, which will reflect positively on the process of teaching and on the students' understanding. One of the purposes of this study is to explore in depth teachers’ views about autonomy for science teachers in Kuwait and to what extent this impacts on their teaching of the science curriculum.

### 2.5.2 Science teaching plan

As mentioned in the previous section, science teachers in Kuwait have to follow the MoE’s curriculum with the guidance of the teaching plan, which is designed each year by the science inspectors in the MoE. Among the duties in the job description of a science inspector are to visit schools, attend science classes, discuss the problems that the teachers face and try to solve them. A subject inspector should have had experience as a teacher for a period of not less than ten years; her/his duties also include the annual assessment of each teacher’s performance and methods to evaluate the quality of teaching.

The MoE sends the science teaching plan at the beginning of each school year to the teachers, who must follow each point in this plan, down to the chronological order in which to teach the curriculum contents. The science teaching plan is designed to distribute the content of the curriculum between the days of the school year and identify to the teacher what topics should be taught and how long each should take (for instance, a lesson on light needs two classes). The science teaching plan also describes the chronological order for teaching the curriculum topics from the beginning of the school year in September to its end in June (for example, the topic of gravity should be taught in the first week of March for one class only). For further clarification, the current science teaching plan [2012/2013] is shown in the (Appendices 8&9). This study will explore in depth the science teachers' views about this teaching plan and its effect on the teaching process, and will look into how this plan was designed by the reformers interviewed in this study.

The previous explanation of the science teaching plan shows that the work of the MoE is centralised and tends to reduce the role of the teachers, giving them no adequate discretion in teaching the content of the science curriculum and confining them within a definite plan devised by others. One of the important points to which the current study would draw attention is the science teachers' views about this teaching plan and its impacts on teaching science. In addition, the current study explores, as part of the relationship between the teachers and the MoE, the centralised system of the MoE's work and its effects on the science teachers and their teaching of the science curriculum.

The centralised nature of the education system in Kuwait and other Arabic states is discussed in many studies, such as the one by Rugh (2002), which acknowledges that the governments in most Arab states including Kuwait are responsible for funding and managing the education system and consequently that the nature of education management is centralised and limited to government officials alone (Rugh 2002). Dagher & BouJaoude (2011) add that the ''determination of science curriculum goals and objectives in many Arab states is centrally controlled by ministries of education (or similar government establishments) and is rarely an outcome of democratic negotiation between various stakeholders'' (p.80).

Al-Momami et al. (2008) found the same in their study of teachers' views on the school curricula in the United Arab Emirates. The results of their study confirm that the Ministry of Education assumes sole responsibility for the development of the teaching plan and the formulation of its goals, for curriculum reform and for other issues related to education, resulting in the centralisation of education in the United Arab Emirates (Al-Momami et al., 2008). This point is made also by Haidar (2000), who explores the views of some professors in different disciplines at the UAE University on the impact of Arab culture and society on science and technology. His study indicates that the governments in most Arab states are primarily responsible for education, managing all aspects of it; perhaps, it says, the prevailing social thought encourages the spread of centralisation as an ideology. Decision-makers always believe that they have the sole right to manage education, which adversely reflects on education in many of these Arab states (Haidar, 2000).

The centralised function of the government and MoE in most Arab states including Kuwait allows decision-makers in these states to monopolise the educational policy and take decisions in such matters as curriculum reform, the formulation of educational goals, preparation of teaching plans, and kindred matters.

### 2.5.3 Professional development programmes for science teachers

Many studies have shown that the MoE does not provide enough training programmes for science teachers; all teachers should be acquainted with the recent developments in their field and thus need to continuously develop their skills. In 2009 the government of Kuwait commissioned the former British Prime Minister Tony Blair to study the reform of Kuwaiti politics, economy and education up to the year 2030 as part of Tony Blair Associates, the ‘umbrella organisation’ for Mr Blair’s commercial operations. Blair reported on the current status of education in Kuwait and the vision of Kuwait by the year 2030; he indicates that Kuwaiti education has ‘two major motives … [in] leading the quality level between the teachers for the students’ achievements; first, selecting the most appropriate people to teach, second, training them to make them qualified and effective teachers’ (Blair, 2009). But the current situation does not bear out these claims. Both the preparation and the training of Education students are insufficient, in addition, the science curriculum in the Faculty of Education is purely theoretical and far from the real conditions of education. Only 1% of Kuwait’s general spending goes on in-service vocational training (ibid).

A study by Khaled (1999) into the status of science teachers found that only 32% had had the opportunity to attend the training courses provided by the MoE. These results were close to the results of my own master's dissertation (Alshammari, 2008). When I asked science teachers if they had attended any professional development programmes in teaching methods, I found that 70% of them in the intermediate stage had not; this percentage is remarkably high. Most of these teachers said that the MoE did not provide any training programmes for them. At the 38$^{th}$ conference of the Kuwaiti teachers' society held on 24/03/2009, the conference confirmed the importance of these training programmes for developing their work and improving performance. The conference also held the MoE responsible for not making training courses available to more teachers. According to Al-Sebeh (2009), some of the conference's recommendations were as follows:

- The Ministry should provide regular training programmes to develop teachers' skills.
- The Ministry should prepare an annual schedule to train teachers; programmes should include both theoretical and practical training.
- The Ministry should provide increased amounts of materials and facilities to train teachers and improve their performance.

All the delegates were dissatisfied with the MoE's failure to provide enough training programmes for teachers' needs. This applies as much to science teachers at the intermediate stage as to other teachers, for without training programmes they cannot improve either their performance or their skills nor review the recent developments in education and science education.

According to Dagher & BouJaoude (2011), the MoE in most Arab states including Kuwait are not interested in providing any professional development programmes or training courses to develop teaching skills and this contributes to the lack of the teaching skills in science teachers. This finding is supported by Ayres et al (2002) in their study about teacher views on the curriculum reform in South Wales, which concluded that it is important to provide professional development programmes for teachers in order to help them become more familiar with the curriculum and this will reflect positively in the students' understanding. Van den Akker (2003) and Fullan (2007) both point out that it is important to provide training courses for teachers in order to raise the standard of their teaching skills.

Authors Ball et al, (1995), add that ''Staff development days in education are still being called curriculum days—and they often just have a focus on the students and the curriculum in schools... They should focus on professional development for teachers because that's going to benefit the kids as well'' (p.21).

From the previous argument it is clear that there are too few professorial development programmes for science teachers in Kuwait, although many studies confirm the importance of improving the provision of such development programmes and training courses for science teachers. In this study I will explore the science teachers' views on these programmes and how often they are provided, in particular those which relate to the new science curriculum.

### 2.6 Student Assessment System

The student assessment system with respect to all the stages of compulsory education in Kuwait is broadly based on the student's passing written examinations. The distribution of assessment grades is different from one educational stage to another but in all stages the student earns the right to advance in the system only by passing the examination in all subjects. If a student fails the examination in even one subject, he/she remains at the same level.

This section focuses on assessment in the intermediate stage, as part of the research context. The student in the intermediate stage is graded in each subject separately, the highest grade possible being 100 marks. A student is considered to have passed if he/she scores at least 50/100. The final grade takes account of several areas, such as activity in the classroom, conduct, cooperation with the teacher and other students, and the homework submitted, but most of each grade depends on the written examination.

When the MoE develops curricula it also changes the student assessment system. In what follows I first explain the old system for science subject assessment and then discuss the new system.

### 2.6.1 The old student assessment system

The old rating system for science subjects was divided into eight assessment periods, with quarterly examinations in each of three terms. According to the Handbook of the Education in Kuwait (1998), all the subjects including science have the same eight assessment periods but the science subjects are different in involving a practical exam where the student conducts certain scientific experiments which he/she has already performed and has been trained to conduct. Consequently, students can be assessed on the extent to which they use the appropriate tools, observe the proper scientific steps, and conclude with the correct results. Table (2.5) below, shows the distribution of assessment grades under these rules for science subjects.

**Table 2.5:** The distribution of old student assessment grades for the science subjects.

| Assessment mode | AP1 | AP2 | AP3 | AP4 | AP5 | AP6 | AP7 | AP8 |
|---|---|---|---|---|---|---|---|---|
| **Written exams** | 15 | 15 | 5 | 40 | 15 | 15 | 5 | 40 |
| **Classroom activities** | 5 | 5 | 5 | 0 | 5 | 5 | 5 | 0 |
| **Practical exam** | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 10 |
| **Total** | 20 | 20 | 10 | 50 | 20 | 20 | 10 | 50 |
| | **200 Marks** | | | | | | | |

***Note:*** *the total score is 200 / 2 (= 100 marks for the final score). AP: Assessment Period*

It can be seen from this table that the total score was 200 marks. The total grade upon which the students' pass-rate in science subjects was determined can be reached by dividing the total score of 200 by 2; i.e. the final grade = 200/2 = 100 marks. (The student passes the exam only by gaining at least 50 marks).

In this student assessment system, the grade for classroom activities was determined by the teachers, and, as stated above, given for the student's level of activity and participation in the classroom, conduct, commitment to attendance, and the performance of homework, while AP4 and AP8 are graded on the results of written and practical examinations only, which were usually more comprehensive than any tests in other assessment periods.

The MoE selected the topics that the student must take in each examination, and determined the dates of exams, which ran concurrently for all schools in Kuwait. The role of the teachers at this point was to comply with such issues and dates as might be identified by the MoE. However, the teachers in collaboration with their colleagues prepared and designed the examinations in their school. This system changed when the change of curriculum occurred, and there is now a different student grading system, which is described below.

### 2.6.2 The current student assessment system

When the new science curriculum was implemented a new and completely different system of student assessment was also implemented. Grades became more substantially dependent on a written examination than they had been in the previous system and assessment periods were reduced from eight to four. Nevertheless, a student must pass in all subjects to move to the next level, the ultimate grade is still the same (100 marks) and a student needs 50 marks to have passed (Handbook of the Education in Kuwait, 2012). The following table (Table 2.6) shows the distribution under these rules of assessment grades for the science subjects.

**Table 2.6:** The distribution of new student assessment grades for the science subjects.

| Assessment mode | AP1 | AP2 | AP3 | AP4 |
|---|---|---|---|---|
| **Written exams** | 35 | 50 | 35 | 50 |
| **Classroom activities** | 5 | 0 | 5 | 0 |
| **Practical exam** | 0 | 10 | 0 | 10 |
| **Total** | 40 | 60 | 40 | 60 |
| | **200 Marks** | | | |

***Note****; Total score is 200 / 2 (= 100 marks for the final score). AP: Assessment Period*

From Table (2.6) it can be seen that the grade for the written examination in each assessment period becomes 35 (from 15 formerly) (Handbook of the Education in Kuwait, 2012). As in the previous student assessment system, the MoE has the authority to determine the subjects in which students will be examined and when this should be done. What has been changed is that the teacher in the previous assessment system was involved in preparing the exams, but in the new student assessment system, the MoE itself prepares the examinations and sends them to the schools. Hence, the teacher has no role in the preparation of exams. The teacher's role is limited to grading the papers and listing the results. Examinations now, unlike those in the past, also become standard at the same level in all schools in Kuwait; the science exams are now the same for all its schools and are taken on the same day at the same time.

Regarding the assessment system in Kuwait and most Arabic states, Shaw (2006) draws attention to the target and role for students in these countries. Where the education system requires the students' success in the examination for passing to a higher grade (i.e., in most Arab states), the student's aim becomes only to pass the examination regardless of the fact that the primary benefits of the lesson and the teacher's performance have been affected, since the teacher concentrates in the teaching process on preparing the students for examination. This is a negative aspect of the education system in most Arab states (Shaw, 2006). In addition, Boujaoude & Gholam (2013) add that the 'assessment practices in science education in many Arab states seem to be focused on recall and lower level cognitive questions*'* (p.350).

Concerning the assessment system in Kuwait, Galal (2013) notes that the current assessment system obliges the student to memorise information, which is prone to be forgotten once the student leaves the exam hall, and that the current assessment system often measures a lower cognitive level than it should. He adds that the current assessment used in Kuwait depends only on a modular exam, in all subjects of which the students are required to pass in order to move to the next grade, and this damages the students' attitude to science and puts them under stress – they think only of how they can pass the exam so as to move to the next stage. Salman (2005) in his research on the education system in Kuwait criticises the assessment system because it depends on a single mode of exam, that of the module. He recommends using different modes of assessment for Kuwaiti students because this will be fairer and give the assessment more validity.

It is clear from the foregoing that the role of the teacher in the students' assessment process has changed by being reduced. The present study will ask the views of both teachers and students on the new student assessment system, which is compared to the previous one in order to identify its most important advantages and disadvantages, before offering significant proposals for developing a better one.

### 2.7 The process of science curriculum reform

The previous discussion has given a general picture of Kuwait's background and education system, concentrating on science education. Here, I concentrate on the reform process of the science curriculum in the State of Kuwait, on which this study pivots. Like other countries, the Arab states are trying to develop and reform their education system, including their curricula, to keep up with scientific advances and developments and technological progress. Keeping up with modern science and technology is a priority for many Islamic countries (Kalin 2006). According to Rugh (2002), the Arab countries including Kuwait have begun to develop education in general by, for example, increasing the number of schools, providing education for all citizens and compulsory education, in particular, for primary and intermediate levels. Rugh reports that many of the Arab states, including Kuwait, have reformed their curricula after they were widely criticised, in that these curricula made students focus on memorisation and concentration, but did not develop problem-solving skills or the application of science in everyday life. Consequently, these curricula have had to be reformed (Rugh 2002).

In 2008 the MoE started to implement its new science curriculum. It was implemented in the $1^{st}$ and $2^{nd}$ grades in 2008, in the $3^{rd}$, $4^{th}$, and $5^{th}$ grades in 2009, in the $6^{th}$ and $7^{th}$ grades in 2010, in the $8^{th}$ grade in 2012 and in the $9^{th}$ grade in 2013. The purposes of this reform are described by Al-Loghany (2011), the Assistant Undersecretary for Education, as those of keeping pace with scientific and technological developments elsewhere and helping students use science and technology to solve their everyday problems (Al-Loghany, 2011).

The head of the science inspectors, Al-Barak (2011), adds in support that the purpose behind the new science curriculum was to give students a grounding in the nature of science; science as a way of knowing; the relationship between science, technology and society; and the use of science in their daily lives (Al-Barak, 2011).

The official aim for the science curriculum reform, as noted by Al-Wetaid, the Assistant Undersecretary for the Curriculum sector in the MoE, was: 'to provide the students with education skills such as self-learning, problem-solving, research, investigation and using science and technology to solve problems in their daily lives, so that they can play an active role in the nation and contribute to the advancement of their country to a high position among the nations of the world.’ (Al-Wetaid 2008)

The reform of the science curriculum included all the necessary curriculum elements: objectives, content, textbooks and student assessment. It was to be completely different from the old one, as Al-Wetaid (2008) stresses: hence, its content, objectives, possible teaching methods, classroom activities and assessment procedures brought changes. The course of this curriculum reform, from its first step until its implementation in schools, is traced in detail below (beginning in Section 2.12).

Unfortunately, no official report or study has so far been issued from the MoE or any government authority in the State of Kuwait containing research on or any analysis of the science curriculum reform. Nor have I found any study published in any scientific journal or presented in any of the scientific forums or conferences that pragmatically discusses this science curriculum reform fully and accurately. To address this problem, I travelled to Kuwait and met some academic researchers in Kuwait University and visited its library. I asked the Public Authority for Applied Education and Training (PAAET) and the Gulf University in Kuwait, which specialise in curriculum matters, whether there were any documents relating to the new science curriculum. I also visited the curriculum sector in the MoE and met its head of department for science and some science inspectors who were working on the process of curriculum reform. From all these meetings, I obtained reports from the reform and adaptation committees and some spoken information.

The only reference that I could obtain about the reform process, apart from the committee reports, was a series of articles written by decision-makers in the Kuwait government and the MoE, which were published by some Kuwaiti newspapers or in other media. The sources include certain domestic forums and seminars, where officials, decision-makers and academicians spoke about the science curriculum reform, together with some domestic opinion polls carried out by newspapers, soliciting opinions on it. In addition, some newspaper articles by education specialists were published.

These confirm what so many studies claim that most Arab countries, including the State of Kuwait, are weak in resources and scientific research. This study examines the lack of resources and of research studies relating to the new science curriculum reform process. Rugh (2002) stated that scientific research is weak in most Arab states including Kuwait and that these states are not interested in, or prepared to encourage, scientific research. Haidar (2000) also asserted that the Gulf States including Kuwait don't support research enough, so a lack of resources and research is found in these states. Al-balushi and Griffinths (2013) agreed with this point and said that this problem faces most of the researchers who are interested in the Arabic context. Dagher & BouJaoude (2011) added that one of the common problems faced by researchers in the Arab states relates to the difficulty of accessing published research.

The foregoing illustrates the timeliness of the current study, which is one of the first to describe in detail and discuss the science curriculum reform in Kuwait and the process of applying it from different points of view – those of teachers, students and decision-makers. I hope that the results of this study will be used to advantage by the officials in the MoE and that it will benefit everyone who is interested in the development and reform of science teaching in Kuwait.

Before any further discussion, it may useful as a background to discuss the old science curriculum, showing the reasons behind its reform.

### 2.7.1 The old science curriculum

The old science curriculum was taught in all the Arabian Gulf states, i.e., Kuwait, Saudi Arabia, the United Arab Emirates, Qatar, Bahrain and Oman, where a unified set of curricula had been in operation since 1985 (Arab Bureau of Education for the Gulf States, 2010). At this time unified science curricula, based on Resolution No. 34/1/2 of the Gulf Cooperation Council (GCC) Education Bureau General Conference in its 8th session, were developed for all member states. These curricula were compiled and prepared by a group of specialists from the different GCC states. The objective behind unifying the curricula was to concentrate the efforts of all states and allow all members to benefit; this would result in the general development of education in the GCC states (Arab Bureau of Education for the Gulf States, 2010).

The old science curriculum faced many criticisms, and studies condemned it for being too weak to adequately develop students' skills, because it focused on memorisation. Most of the studies recommended that it should be reformed and developed.

A study by Mohamed (1998) considered the content of the science curriculum for intermediate students. His results indicate that the accumulation of information in this curriculum was a travesty, presenting knowledge in a direct way, which invalidates one of the most important objectives of teaching science, i.e. the development of students' own abilities to research and deduce. Mohamed recommended reforming it so as to help students develop their thinking and problem-solving skills.

A study was conducted by Al-Ahmad (1999) on a group of $6^{th}$ year and $8^{th}$ year students, with the aim of identifying whether the science curriculum developed their problem-solving skills. The researcher tested a group of students to measure their skills in this regard. The results show that the curriculum could not train students to use problem-solving skills to resolve scientific questions, being focused instead on memorisation and recall. The study recommended reforming and upgrading this curriculum in order to develop a variety of scientific skills.

These conclusions were in sympathy with those in a study by Ali (2000), evaluating the science curriculum for $7^{th}$ year students in Kuwait. He confirmed that this science curriculum, in spite of its importance, still focused upon items of knowledge and was considered a source of information and knowledge which called upon memory but not on such intellectual areas as would be needed for deduction. He also recommended that it should undergo reform.

A study by Al-Rashed (2000) dealt with the content of the old science curriculum for $8^{th}$ year students. The researcher analysed the content of this curriculum and found deficiencies in the number of lessons and scientific experiments that helped students to use science for solving everyday problems or make use of scientific facts. The researcher stated that most of the content of the science curriculum focused on theory and was not much concerned with practicalities. This study also recommended reform and development.

Jassim (2002) assessed how far the science curriculum for primary and intermediary stages addressed the dimension of scientific literacy. He analysed the content of the curriculum with his own analytical tool, finding that only 9.2% of the content of the primary education curriculum contained dimensions of scientific literacy, while the intermediary curriculum contained only 9.5%, which in his view was very low. The study recommended developing the science curriculum to include different ways of helping students to be scientifically literate.

Studies by Al-Quhtany (1999) and Mullah (2000), discussed the science curriculum and student ability. Al-Quhtany implemented science testing to explore students' scientific abilities and indicated that most students in the intermediate stage in Kuwait lack abilities and skills in this regard and most of them failed to answer the questions which needed critical thinking. Mullah, (2000) accepting the results of Al-Quhtany's study, added that students' attitude to science is discouraging; he calls on the MoE in Kuwait to take an interest in developing the students' scientific skills, such as critical thinking, investigative skills and self-study skills. He also recommended developing the science curriculum to improve these abilities.

Other studies focused on the old science curriculum and the teaching methods which are used with it. Saed (1996) focused in his study on teaching methods which are used by the science teachers in the ninth grade of Kuwaiti schools and concludes that most of the science teachers use traditional teaching methods by transferring ideas directly to the students, requiring them merely to listen to the teacher and keep notes. He claims that not diversifying one's teaching methods in the classroom have a negative effect on the students' understanding and their attitude to science. In 2002 came a study by Fahad, who focused on science education in the primary stage in Kuwait and asserted that most students have difficulty in understanding science lessons. She concluded that one reason for this may be that most of the science teachers were using traditional methods of teaching, such as lecturing, and this accustoms the students to obtaining ready information and memorising lessons in order to retrieve the information at the time of the examination. She discussed another reason for not varying the teaching methods in science classes, which is the large number of students in each class. This is in agreement with some studies (Talal, 2000; Saad, 2001) which stated that all the classrooms in the schools of Kuwait often hold a high number of students. These studies also assert that the great number of students in a classroom hinders the teachers from using different instructional tools or varied teaching methods, as well as hindering collaboration between pairs or in groups and general classroom discussion.

In addition, Galton (1998) asserted that reduction of class size is necessary to improve the quality of the teaching and students' performance. This would help to increase the interaction between teacher and student, such as sitting alongside pupils to mark their work, monitoring student-student conversations, and carrying out various housekeeping duties such as sorting books and tidying up after practical work in science.

Another negative in the science education system in most of the Arab states including Kuwait is that instructional tools and modern technology for use in teaching are not available in most schools (Haidar, 2000; Rugh, 2002; Al- Momami et al., 2008; Al-balushi and Griffinths, 2013).

In addition, Nashwan (1993) analysed the science curriculum in 11 Arab countries including Kuwait and found that they: 1) do not help students to take care of their health; 2) do not develop problem-solving and thinking skills; 3) do not help students' creativity; and 4) ignore students' backgrounds, interests and environment. The study by Badran (1993), which assessed the science curricula in the Arabic-speaking Gulf states (Kuwait, Saudi Arabia, Bahrain, Oman, Qatar and United Arab Emirates), also noted that these curricula do not use the new technologies in teaching science and do not help students to address their social and environmental problems.

Shaw (2006) confirmed that the science curricula in the Gulf countries do not develop sufficient scientific skills among the students and are more theoretically than practically based. Shaw revealed that the effect of this is that most citizens in the Gulf countries enrol in tertiary colleges to follow literary disciplines, such as sociology, history and Islamic studies in preference to disciplines such as science and mathematics. He found that the reason may lie in the curricula, which do not encourage students to attend colleges with scientific disciplines. He therefore considered that in the curriculum, society's needs ought to be borne in mind and students should be encouraged to pursue scientific disciplines (Shaw, 2006). In the same chapter, Shaw handled the issue of education reform in the Arab states and warned that education reform, including curricular reform, will not be carried out easily, but will take a long time. Shaw believes that one of the reasons for this delayed reform is the centralised action of the Ministry of Education in most Arab states (Shaw, 2006).

All these studies demanded reform of the old science curriculum and this was also brought up by the World Bank report (2008), which called for reform to any science curriculum in the Arab states (including Kuwait) that does not prepare students to be productive in the 21st century. The problems with the quality of science education in most Arab states including Kuwait are evident from their use of outdated science curricula that do not focus on preparing future citizens who are capable of decision making in the 21st century (BouJaoude, 2010).

The above lays out the clearly weak and unsatisfactory state of the old science curriculum in Kuwait and the need to reform and develop it. After all these studies, the MoE in 2002 began its re-development during a wholesale reform of the education system. This was outlined in the study of Dagher and Boujaoude (2011), who found that many Arab states (including Kuwait) have had plans for comprehensive educational reforms in the last three decades, including a redeveloped school curriculum, improved teaching skills, higher national education standards and better education policy.

The questions to consider next are how it was thought the science curriculum was to be reformed and what were the stages in the process of curriculum reform. In view of the lack of any official or academic studies of the reform, one of the relevant documents is the Educational Strategy Project for Kuwait (ESPK) which extends until 2025, and the reports of the reform and adaptation committees. Some newspaper polls, articles and interviews with policy-makers who were working in curriculum reform also helped me to discern the process.

In the next section I list the steps taken by the Kuwaiti government and MoE to reform the science curriculum. I start with the strategy planned to last until 2025, then consider the committees of curriculum reform and adoption and finally discuss some of the different views on the reform and implementation of the science curriculum.

### 2.7.2 The Education Strategy Project for Kuwait before 2025

After many years and many studies recommending development for areas of education in Kuwait, the government prepared a strategy to extend to 2025; this was the first official step that had been taken for this purpose. The Council of Ministers in Kuwait entrusted the preparation of a strategy for educational development to the Supreme Council for Planning (the authority responsible for creating the necessary plans for development in all fields in the State of Kuwait). The strategy prepared in 2001 by the Supreme Council for Planning in collaboration with UNESCO's Regional Office in the Arab states was to create a project for educational development in Kuwait as far as 2025. The strategy described the issues facing the country's education under fifteen headings, or themes, along with recommendations for reform and development. The fifteen themes were: educational structure, types of education, student learning, measurement and evaluation, curriculum, learning methods, the school environment, teachers' pre-service education, applied education and training, higher education, scientific research, literacy programmes, special needs education, educational administration, and spending on education.

The purpose of the strategy was to identify the recommendations to develop education in Kuwait in the above fifteen areas. In the science curriculum the strategy identified some general problems, namely:

- Lack of development of self-learning,
- Weakness in formulating the curriculum objectives,
- Failure to develop students' critical thinking skills,
- Failure to develop students' creative abilities,
- Failure to develop a link between curriculum content and the students' lives.

The strategy also referred to other curriculum problems, such as students not changing the habits they had acquired in general education – i.e., of merely receiving information – because the system consisted of rewarding those who were able to memorise and recall in examinations the information given to them beforehand. As a result, they did not have enough opportunities to practise thinking, critical approaches or problem-solving (ESPK, 2001).

The project determined that the reform of the science curriculum was necessary and provided a set of general recommendations to consider when engaging in such reforms, namely:

1. Students' scientific thinking skills should be developed; specifically, critical thinking, problem-solving, analysing findings and forming conclusions;

2. A love of innovation should be fostered among students, with the curriculum not depending on the relay of ready information to them;

3. Schools and teachers should be given the opportunity to participate and share opinions and ideas about curriculum reform;

4. Schools should be allowed flexibility in implementing curricula, such as developing hands-on exercises and topics, as well as diversified schemes which would contribute to the development of students' abilities, such schemes being supervised and assessed by science supervisors;

5. The correlation between the key objectives of the science curriculum and secondary objectives should be increased, so that these objectives would be both readily applicable and easier to achieve;

6. The private sector should be encouraged to participate in curriculum development, meaning that such participation should not be limited to the MoE.

To this end, the strategy recommended some ways of reforming the science curriculum. When the strategy was completed, the Supreme Council for Planning sent it to the MoE to use as a reference or overall framework in developing education. The content mentioned in this strategy represents the overall strategy for developing education in Kuwait and may be considered an overall framework or starting point for the MoE to adopt.

From the previous discussion it is clear that this strategy functions as a reference for the curriculum reform in addition to the many studies which called for reforming and developing the science curriculum. However, the unique advantage of the strategy was that it had been prepared and issued by the Kuwaiti government and can thus be regarded as the first formal step in the reform of the science curriculum. In the next section, I discuss the remaining steps taken by the MoE in this process, from the choosing of a fresh curriculum to implementing it.

### 2.7.3 The phases of the science curriculum reform

After one year of the strategy, the MoE in 2002 started the process of science curriculum reform for all grades in the primary, intermediate and secondary schools. The first practical step taken was to form a committee for this purpose. According to the report of the science curriculum reform committee (2002), the MoE formed a curriculum reform committee in October 2002, to make plans and develop a suitable strategy. This committee was chaired by the Assistant Undersecretary for the Curriculum sector at the MoE and made up of the head of the science inspectorate, some science inspectors and some staff from the Curriculum sector at the MoE.

The purpose of the reform committee was to make a plan and a framework for the reform itself. After many meetings, the first decision of this committee was to become independent from the unified science curriculum which had been taught in all the GCC states since 1995 without changing or developing; and at the same time to begin work on reforming the science curriculum in their own country. Al-Rabeah (2004), who criticised the unified science curriculum and sought to reform it, mentioned that one of the disadvantages of the unified science curriculum in the GCC was the difficulty of negotiating any changes in it when the approval of all the member countries was needed. This, according to Al-Rabeah, was one of the reasons for the delay in reforming it (Al-Rabeah, 2004).

After the first decision concerning independence, the committee decided to select a science curriculum which was already in use elsewhere; before implementation this would be modified, adapted and reviewed to meet the nature and needs of Kuwaiti society and its culture. These three phases, the *selection, adaptation* and *implementation* of a new curriculum are discussed below in more detail.

**Phase one: Selecting the new science curriculum**

The reform committee spent some time deliberating and in 2002 finally chose a series of curricula which had been published in the USA by the firm of Pearson-Scott Foreman (Al-Barak, 2011). The committee gave as the reason for this choice that the curriculum had already been tested and taught in the USA and Lebanon, so it would require no further testing and would thus save time. It needed only to be reviewed and adapted before it could help to achieve the objectives of teaching science in Kuwait (Al-Barak, 2011).

The reasons for picking out this specific curriculum from all the rest and the details of the nature of the work of the reform committee are not clear from the available resources. Some questions need answering about this reform process and the choice of a particular curriculum, such as how it was made and why; how these committees worked; how the original curriculum was translated from English into Arabic; and other related questions. One of the tasks of the present study is to explore in detail the process of this reform. The questions listed above are behind the questions asked in the interviews and questionnaires in the present study, which tries to find out more about the methodology and reasoning that led to this particular choice.

After selecting the new science curriculum series and translating it into Arabic, the MoE wanted to review and adapt it so as to connect it with the culture, religion and environment of Kuwait. The next section discusses the curriculum adaptation phase.

**Phase two: Adaptation of the new science curriculum**

Six years after choosing the new series of science curricula, the MoE on 27/04/2008 issued Resolution No.30115, in order to form the curriculum adaptation committee. The committee again consisted of the head of the science inspectors, science inspectors and staff from the curriculum sector of the MoE and was chaired by the Assistant Undersecretary for the Curriculum sector. According to the reports of the science curriculum adaptation committee (2008), the task of the adaptation committee was to adapt the new science curricula to ensure that they were relevant and suitable for the Kuwait student, raise comments and indicate amendments, if any. The curriculum adaptation extended to its content, objectives, methods of assessment and textbooks. The committee also reviewed such details as the examples in the textbook, its pictures, the clarity of the font and quality of the paper.

Adaptation subcommittees were formed under the supervision of the main adaptation committee. A subcommittee was assigned for each grade of compulsory education. Each subcommittee was composed of four science inspectors and two members of staff from the Ministry's curriculum sector. When the committees had completed their task of changing and modification, the curricula were sent to the main adaptation committees to take action, give feedback and make final decisions. The adaptation process began with the primary stage curriculum, because the MoE's plan was to introduce the new curricula gradually, starting with the primary schools. After the work of adaptation had ended and the final draft of the new science curricula was confirmed by the Assistant Undersecretary for the Curriculum sector, the new science curricula were printed in their final form and distributed to the schools to be taught.

As noted above, it has been hard to find published references to the curriculum reform process in Kuwait, so it not surprising that the adaptation process raised questions that need to be answered about the way that it was done and whether any specific and consistent standards were employed throughout the process of review and adaptation. The nature of the work and the process of curriculum adaptation is one of the significant areas of the present study and questions on them are included in the interviews and questionnaires.

**Phase three: Implementation of the new science curriculum**

The new science curriculum was implemented gradually in the first and second grades in 2008, with the third, fourth and fifth grades added the following year. The (intermediate) sixth and seventh grades were added in the 2010 school year, the eighth grade in 2012 and the ninth grade in 2013. The new science curriculum was implemented directly in all schools without any form of piloting; and no plans were made to train any teachers in teaching it, although it was completely different from the old one. The head of the science inspectors mentioned that the reasons for not providing training for all the science teachers was that the Ministry did not have adequate facilities for training them all and hence it had provided training to section heads only, who would in turn train the teachers in their schools. He said that the new curriculum had not been piloted in advance because there was not enough time. The plan had been to review the curriculum after its implementation (Al-Barak, 2011).

Piloting the new curriculum before the full implementation is important in any curriculum reform and development process. This point is made by studies such as the one produced by the International Training and Education Center for Health (I-TECH, 2008), which indicated that: ‘‘The purpose of piloting a curriculum is to make sure the curriculum is effective, and to make changes before it is distributed or offered widely. Piloting a curriculum helps to identify which sections of the curriculum work and which sections need strengthening’’ (p.1).

In addition, Corbett, Gardner & Taffaro (2013) in their conference paper about piloting a new curriculum observe that teachers’ feedback about the new curriculum is important for the success of any new curriculum, so piloting the new curriculum before it is implemented is important. They confirm that curriculum piloting helps to investigate the mistakes and obstacles in advance and listening to the views of the early users of the curriculum and their feedback would have helped to develop the new curriculum and make it successful.

One of the criticisms of leaving out a pilot project was raised by the Al-qabas newspaper on 23/11/2012, in an article entitled ‘New science and mathematics curricula: new predicament of education’. Al-qabas conducted a poll of academicians specializing in teaching science in Kuwait. In connection with this, Al-Shatti, a science lecturer at the Basic Education College in Kuwait, strongly criticised the failure to pilot the curriculum before implementing it; he said ‘Our students are not a field test’, indicating that he thought it had many flaws and included many topics which were irrelevant to Kuwaiti society which could have been remedied by piloting it. Al-Shatti (2012) called on the MoE to provide training courses for science teachers on the new science curriculum.

Further, the immediate implementation of a curriculum so soon and without piloting gives teachers no chance to study the curriculum, which negatively impacts on their performance, as noted by Al-Shaiji (2011) in her study of the evaluation and analysis of a new Arabic language curriculum for the first and second grades in primary schools in Kuwait. She pointed out that this curriculum is full of flaws, such as over-complexity and the accumulation of information, which together made it unduly hard for primary students. The content was not graded from easy to difficult, and the student assessment questions at the end of each lesson did not consider individual differences between students. Regarding teachers and students, Al-Shaiji reported that teachers found great difficulty in teaching this curriculum, for several reasons, in spite of its total difference from the previous faulty one. One reason is a failure by the MoE to test the curriculum or to allow teachers the opportunity to peruse it; moreover its length and extent were incompatible with the time allocated for teaching it. All these factors affected the teachers' performance in the classroom. In her study Al-Shaiji proposed reconsidering this curriculum in field studies in schools and listening to the problems experienced by teachers, students and parents. She claimed that this would help to create a curriculum linked to the students' lives, which took into account the individual differences between them. She stressed the need to have tested the curriculum before it was widely implemented (Al-Shaiji 2011). Al-Shaiji's study is relevant to the fact that the MoE neglected to pilot the new science curriculum, because it pinpoints the reasons for failure in the omission of a pilot and its impact on students and teachers when it was taught.

Because the new science curriculum was implemented in the schools too early it faced criticism from some teachers and students. These criticisms are not officially reported by the MoE or the Kuwaiti government and no study or research has discussed the views of the teachers and students on the new science curriculum, so all the written criticisms of this new curriculum come from newspapers. But I hope that one of the results of this study will be a discussion of the new science curriculum in grades six and seven, giving the in-depth views of teachers and students, which will help the policy-makers in Kuwait develop science education with some knowledge of what these users think.

One of the important criticisms of this curriculum was made at a students' sit-in outside the offices of the Ministry of Education on 4th November 2013 (Figure 2.2) (Alaan newspaper, 2013). This sit-in by hundreds of students lasted a whole day and called for a change in the new curriculum and the new assessment system. The students felt that the new curriculum was very difficult to understand and too wide in content, complex and boring. In addition, they criticised the new assessment system which they called unfair and claimed put them under intense stress because it made more depend on the module exams; the students wanted to be assessed in a different way and to have some marks allocated to classroom activities. The MoE did not respond to them and the new science curriculum and assessment system have not so far changed in any way.

This study explores the students' and teachers' views in depth about the new science curriculum and explores the challenges which faced them in teaching and learning science and gives them the chance to explain their suggestions for the improvement of the new science curriculum and science education as a whole.

**Figure 2.2:** Students sit-in in front of the MoE in Kuwait (Alaan newspaper 2013).

## 2.8 Kuwaiti students' results in the TIMSS tests

The most obvious pointer to the existence of problems in the education system in Kuwait is reflected in the modest performance of the Kuwaiti students in international examinations. ''TIMSS is an international assessment of mathematics and science at the fourth and eighth grades that has been conducted every four years since 1995'' (Martin, Mullis, Foy and Stanco, 2012, p. 5). According to BouJaoude & Gholam (2013), ''In the absence of comparative data on the achievement of Arab students, results of international comparisons in science and math such as TIMSS and PISA can be useful to gauge the quality of learning of students in the countries that participated in such comparisons'' (p.345). Kuwait participated in the TIMSS test in 1995, 2007 and 2011. The test results for Kuwaiti students in the years before the science curriculum reform were disappointing. Many specialists criticised these results and considered that they reflected the weakness of science education in the country. Some found the science curriculum responsible for this weakness, because it did not develop the capacity and skills of the students but focused on memorisation only. The TIMSS test score for Kuwaiti students in 1995 was 401 and it ranked 39$^{th}$ out of 41 participating countries. In 2007, Kuwait got 348 points, ranking 38$^{th}$ out of 48 countries.

After the science curriculum had been reformed, Kuwait participated in the TIMSS test in 2011. The MoE hoped that its students would gain better results, because the new science curriculum, as the officials in the MoE affirmed, develops the abilities and scientific skills of the students in such areas as problem solving, research and deduction. However, the results were once more disappointing; Kuwaiti students earned 347 points and were ranked 47$^{th}$ out of 60 participating countries. In addition, Kuwait came last out of all the Arab Gulf countries participating in the test (Martin, et al, 2012). Comparing the results of Kuwait in 2011, after the advent of the new science curriculum, with the results attained in 1995 and 2007 when the previous science curriculum was in operation, it is clear that the scores went down even below the totals for 1995 and 2007, while the ranking of Kuwait sank lower. This indicates certain defects, denoting that science education in Kuwait faces problems which persist and which the new science curriculum has not solved but rather has exacerbated.

The first official reaction from Kuwaiti officials came in a press conference held in Kuwait on 12th December 2012 to discuss the results of the TIMSS tests. Dr Reza Al-Khayat, Director General of the National Center for Developing Education in Kuwait, admitted that the results were disappointing and contrary to what had been hoped and expected. He also indicated that after the results of Kuwait in 2007, the MoE had sought to remedy the defects in science education in Kuwait and tried to combat its shortcomings. Among the steps taken was reform of the science curriculum for all grades, but the TIMSS test results for 2011 were the opposite of what had been aimed at.

Al-Khayat said: ‘The National Center for Developing Education, in cooperation with the MoE, will analyse the TIMSS test results to detect the places of weakness of the students in science and design a plan to develop science education in Kuwait’ (Al-Khayat, 2012). After the announcement of the results, the MoE in Kuwait declared that he was not satisfied this time with the country’s science results, which were disappointing. He affirmed that the MoE would review and analyse the students’ results in order to make a comprehensive plan for developing the science curriculum and remedy the defects in the teaching of science (Al-Khayat, 2012).

It may not, of course, be possible to judge the failure of the new science curriculum entirely from the results of the TIMSS because the test is on grades 4 and 8 only, but this test gives an indication that there are great defects in both the science curriculum and in the general process of teaching science in Kuwait, whose causes can only be determined by comprehensive detailed study.

Regarding the low results of the Kuwaiti students in the TIMSS test, this study will explore the decision-makers’ views about these results and suggest how they can benefit from the study. In addition, this study looks at the shortcomings and weaknesses in the new science curriculum and in the science teaching process in general by identifying different views among the teachers, students and decision-makers. It is also hoped that officials in the MoE will benefit from the results of this study in their reform and development of the science curriculum in the future.

## 2.9 Importing a Western science curriculum to teach in the Arabic States

As can be seen, the MoE in Kuwait imported a Western science curriculum from the USA and adapted it to suit Kuwait's culture, Islamic religion, social needs and environment. In this section I want to discuss how an imported Western science curriculum can be used in Arabic States and what its impact has on education, together with the advantages and disadvantages of this process.

In the last few years Kuwait and some other Gulf states have reformed their science curriculum by importing a Western curriculum which must be adapted before it can be taught in schools. In the UAE, the MoE adapted a science curriculum series published by Harcourt, an American publisher (Alqasemy, 2013). In Bahrain and Saudi Arabia, the science curricula published by McGraw-Hill (a US company) was adapted to suit each country's culture, society and environment (Obeikan Education, 2012). Donn & Almanthri's book (2013) about the experiences of Middle Eastern countries in curriculum development has a chapter by Al-Balushi and Griffiths (2013) describing the experience of Oman in this regard. They say that the curriculum in Oman in 1970 was designed and brought over from other Arab states ready for use, without even consulting Oman itself. During the period from 1980 to 1990, Oman requested some Arab states, such as Egypt and Jordan, to prepare special curricula for it. However, a science curriculum which had been prepared and designed by a group of specialists from all the Gulf Countries was standardised for them all. In 2010 Oman procured coaching by specialists from North America and Britain to assist it in developing its curriculum including that for science; it is still (2013) in the process of curricular development and reform in collaboration with such experts. Al-Balushi and Griffiths also write of several Arab states, in particular the Arab Gulf countries, requesting the help of international organisations for the development of their curricula (Al-Balushi and Griffiths, 2013).

It will be clear from the above that most of the Gulf States including Kuwait started to reform their science curriculum by importing one which had been designed in a Western context.

Some studies such as that by Dagher and BouJaoude (2011) discussed the adoption by Arab states of curricula from a Western country without regard for the culture in which it would be implemented, thus affecting their quality and the ability of teachers to integrate science in the students' everyday life. Importing a Western science curriculum to be taught in an Arabic state clearly may exert its influence on the development of the education system, the design of school curricula, and the willingness of students to study, and may result in changes in the content for a less secular population (Bashshur, 2009).

Mansour (2009) criticised the impact of importing foreign international organisations to help in reforming the science curriculum in Egypt. His results showed that some teachers think that the current science curriculum reflects Western international culture and ignores Arab scientific culture, which adversely affects the identity and interest of the students involved.

According to Baker and Taylor (1995), the use elsewhere of a science curriculum for Western countries may be ineffective and unable to achieve the objectives of teaching science in these countries because it does not relate to the culture of the community. Waldrip and Taylor found the same, stressing that such an introduction adversely affects the students' learning of science because the culture of the community has a significant impact on science learning (Waldrip and Taylor, 1999).

Another study is by Aydarova (2012), who looked at an imported Western curriculum in the Arabian Gulf. Aydarova observed that the significant actors' interpretations of the local culture, context and students' abilities play a central role in the success of a Western curriculum in the Gulf States. She stated that the content of the Western curriculum has to be related to the students' culture and environment and the teacher has to be carefully selective about the content, because some topics, such as premarital pregnancy, may be considered offensive in the local conservatively Islamic society. Her study focused on the UAE and asked teachers about the Western curriculum which was being taught there. Many teachers believed this curriculum to be 'unusable' because it was too hard for the students. In their opinion, adapting it for the local context would require 'dumb[ing] it down' even further. This study concluded that a Western curriculum would have to be adapted drastically to be suitable for the students' social culture in the UAE and that professional development courses would have to be provided to familiarise the teachers with the new curriculum (Aydarova, 2012).

Many Arab states have developed or are reforming their science curriculum as the UAE has. The experience of the Kingdom of Saudi Arabia is considered the closest to the experience of Kuwait. In addition to similarities in the manner of the reform, the Kingdom of Saudi Arabia is geographically close to Kuwait and its culture is largely similar with respect to lifestyle, customs and traditions. It may be helpful to discuss the experience of science curriculum reform in the Kingdom of Saudi Arabia in more detail.

A conference paper by Al-Shaya and Abdulhameed (2011) talked about the development of a science curriculum in Saudi Arabia. These researchers described how a series of science curricula was designed and prepared for science teaching in Saudi Arabia by McGraw-Hill. The MoE in Saudi Arabia, in collaboration with the Al-Obeikan Company, translated it into Arabic and adapted it to suit the culture of Saudi society. The science curriculum reform process was carried out in stages which are scheduled for completion in 2016.

The two writers described the purpose of this reform as creating a generation that could solve its problems and social difficulties and contribute to the construction and development of their homeland. It should also develop the intellectual powers of the students, such as their problem-solving skills, capacity for innovation and use of technology according to the latest scientific standards. Hence, the MoE sought to obtain an international curriculum to fulfil these purposes. However, although the science curriculum in the Saudi Arabia is up-to-date, it has attracted much criticism as has the process of reform itself, including the following:

- The state’s failure to provide adequate training courses for teachers on the new curriculum;
- The state’s failure to ensure the direct involvement of teachers in the reform process of the science curriculum;
- The lack of modern educational and technological means for delivering the new science curriculum;

- The failure to provide an education plan that conforms to the new curriculum content;
- The state's failure to familiarise some teachers with the method of teaching for the new science curriculum; and
- The difficulties faced by many students in a wide range of science lessons.

This resembles exactly what has happened in Kuwait, where the new science curriculum was designed in the USA; this is one of the factors that led me to conduct this study. As most studies conclude, a curriculum should relate to the society's culture and environment, taking into consideration the needs of the people. Therefore, one of the objectives of the current study is to explore the relevance of the new science curriculum to the culture, environment and needs of Kuwait.

From the previous argument it is clear that there are problems in importing a Western science curriculum because the social culture and religion of the Arab states are not the same. So, has this process failed in Kuwait? Can a Western science curriculum never be taught in an Arab state? Other studies discuss the importing of a Western science curriculum from different viewpoints.

One of these studies was by Al-Daami and Wallace (2007). It maintained that Western ideas have greatly impacted on Jordanian school curricula ever since the time of British rule over the state, on account of its strategic significance and its economic dependence on the West. Thus, the US, the World Bank and the EU all assist the financial, developmental and military effort in Jordan. It was recently noted that Jordan amends its education service through the process of curriculum improvement, concentrating on cohesive cultural ideologies drawn from Islamic rituals and Western developmental claims. Moreover, it should be mentioned that the alien Western curricula have had a positive, inspirational and socially progressive influence on the country. The impact of Western curricula helps the national curricula to keep up with technological advancements in a world ruled by globalisation, and the national curricula contain the newest terms devised by modern scientific inventions at the same time as being committed to local customs and traditions.

El-Baz (2004) had a positive view of importing Western curricula to the Arab states. His article noted about the curricular reforms in Arab countries that these countries have to develop their education by benefiting from the advances in education and technology in Western countries. He claimed that the education in Western countries produces skills in teachers and students and also curricula which are better than their equivalents in Arab states, so the latter have to cooperate by importing Western curricula. This article concluded that education for the Arab states has to be open to the rest of the world and not enclose itself because this would hinder the development of these states. The development in Western countries brought about by the educational experience must be shared and reviewed in an open-minded way so that the best can be adapted for particular local settings (El-Baz, 2004).

In addition, Aikenhead, (2008) in his study supported the importation of science curricula from Euro-American countries into Asian countries, and suggested making a balance between different cultures by two strategies: the first strategy is called a cross-cultural perspective, while the second strategy is called the relevant world of science-related events. But it is worth mentioning that both of these strategies are based on educators' cooperation and efforts. Where there is a cross-cultural strategy, instructed students have to extract the knowledge from Eurocentric sciences, without being integrated into their culture or being influenced by it. To reach this strategy, science educators must recognise and evaluate the religious and ideological bases hidden inside conventional Eurocentric curricula, which means studying the epistemology, sociology, and history of Eurocentric sciences. Regarding the second strategy, it focused on the educational relevance of school science and on the political reality of who decides what is relevant? Which in other words make a balance between importing Euro-American science programmes and promoting culturally sensitive school science to meet local needs, and paying attention to political issues that may limit these matters.

The above suggests that importing a Western curriculum to an Arabic state may benefit and contribute to developing Arab education, but the reform needs to be implemented carefully because suiting the social culture context and religion plays a major role in successful curriculum reform, so the adaptation process is important in relating the science curriculum with the students’ culture, needs, religion and environment. Science curriculum reform with regard to the social-culture perspectives are discussed in detail in the next chapter. One of the aims of this study is to critically evaluate the reform of the science curriculum and to what extent the reformers consider the impact of the social culture, Islamic religion, and social needs when they adopted the western curriculum.

## 2.10 Summary of the chapter

As has been mentioned, the size of government spending on education is significantly large in relation to the small size of the State of Kuwait and of its population. As described, the details of the science curriculum reform process in the above account make it clear that the process of curriculum reform was conducted by decision-makers in the MoE without the involvement of teachers and students and only after calls for reform by many specialists. The phases of the reform process included only the selection, adaptation and implementation of a curriculum used elsewhere. The MoE imported a foreign science curriculum which had already been implemented in a Western country, adapted it to suit the culture of its own society, and subsequently implemented it without testing or training. This is a general outline of the reform process in question, but has none of the details which were supplied from interviews with the reformers who conducted the process of developing and reforming the curriculum. These details will help to identify the features, causes, goals, steps and participants in the reform process, as well as other related items.

The importance of this study is based on the fact that it is the first systematic study in Kuwait of the details of a specific reform and it links together the different views of the decision-makers, teachers, and students involved. Accordingly, the results of this study will be able to serve as a reference for the MoE staff in introducing further curricular developments in Kuwait.

The review of the literature which touches on the process of developing and reforming the science curriculum is presented in the next chapter.

# Chapter 3

# Review of the Literature

## 3.1 Introduction

In this chapter the literature which relates to the aims of this study is reviewed. Many people have written about curriculum and science curriculum reform and so, after reviewing the range of possible sources, those which were chosen were closest to the context of the study starting from a definition of the curriculum and ending with the relationship between science and the social-culture.

This chapter starts by describing the curriculum in general, providing background to it as a concept, defining it and its components and assessing its importance. Then two different sections focus more closely on the latest reforms of the science curriculum around the world: the first gives a brief background to it, with its meaning, importance and implementation; and the second looks at why it needed reforming and discusses the roles of teachers and students in the reform process, to assess the importance of their views on curriculum changes of any kind.

The next part of this chapter concentrates on science curriculum reform in a socio-cultural context, as the study's particular concern. This outlines the theoretical framework of socio-cultural theory and in particular the Arabic socio-cultural context. This requires discussion of the Islamic religion; hence the relationship between science and religion occupies a further section, asking how religion can relate to the learning of science.

## 3.2 The nature and importance of a curriculum

The idea of a curriculum in teaching is not new; the way in which it is understood and theorised has changed over time. The literature review in this section begins by critically considering the nature of a curriculum within its different definitions, its importance and its use, before acknowledging the importance of the science curriculum.

The historical roots of the word curriculum are particularly revealing. The Latin meaning of the word translates as ‘racecourse’ (Marsh, 2009; Su, 2012; Toombs & Tierney, 1993). Indeed, a modern school curriculum could be likened to a race, whereby obstacles and challenges are put in the learner’s way and other students are competed against. Over recent years there has been a substantial increase in the number of definitions and the breadth of its meanings (Marsh, 2009). In the next section the different definitions of ‘curriculum’ are discussed and one is chosen for use in the present study.

### 3.2.1 Defining ‘curriculum’

In the field of education, one finds many definitions of ‘curriculum’, which have been widely discussed (Beauchamp, 1982; Marsh, 2009; Portelli, 1987; Su, 2012; Toombs & Tierney, 1993). Portelli (1987) refers to the work of Ian Rule who in 1973 ‘identified 119 different definitions of the term ‘‘curriculum’’ (p. 357). Since then, even more have emerged (Portelli, 1987), without any consensus. It is a complex and multifaceted term that scholars have struggled to simplify. Marsh (2009) claims that defining the curriculum is no easy matter and that writers naturally formulate a definition of the term in line with their latest findings. The major concern of education writers is that the term is so broad and multi-dimensional that it can cause much confusion and inconsistency. Portelli (1987) and Toombs and Tierney (1993) are critical of definitions that tend to over-emphasise certain aspects of the concept at the expense of others (content over structure, for example). However, Su (2012) does not agree with this, but finds that a variety and plurality of definitions contribute to a greater understanding of its different dimensions.

Some of these many definitions deserve to be discussed: does ‘curriculum’ mean what is to be taught and how? (Alexander, 2001). Kelly (2009) defines it as all the learning which is planned and guided by the school, whether it is carried on in groups or individually, inside or outside the school (Kelly, 2009). Marsh & Willis (2003) see the curriculum as the learners’ experiences under the guidance of the school. It is important when exploring the curriculum that both the above definitions are kept in mind since, for Kelly, considering either alone would be insufficient and restrictive (Kelly, 2009). According to Wiles and Bondi (2007), ‘‘we see the curriculum as a desired goal or set of values that can be activated through a development process culminating in experiences for students.'' (p. 5)

'Curriculum' can also be defined as a kind of formal or informal process which leads to a specific set of items of knowledge, changes, attitudes, skills and activities to be delivered to students under the supervision of teachers or a school. Or it can be defined as the process when the learner faces different aspects of the environment while teachers guide him/her. Thus, a good definition for the word is a sequence of learning opportunities provided to students in their study of specific content (Barani et al., 2011). This all-encompassing notion of curriculum is summarised by Kyriacou, who suggests that it covers every one of the students' experiences related to learning. He further emphasises the breadth of the notion of curriculum by suggesting that it has four key elements: educational aims and objectives, content, teaching methods, and outcomes and assessment practices. He supports this by explaining that analysis of the curriculum should include considerations of both the formal curriculum and the hidden curriculum (Kyriacou, 2009).

Toombs and Tierney (1993) stress the need for clarity of meaning and operational terms, something that cannot be achieved with too broad a definition. They point out that 'curriculum as a concept, as a discrete idea, is almost without boundaries' and that 'it can mean anything from the 'bundle' of programs an institution offers to the individual experience of a particular student' (p. 177).

In other views, as van den Akker (2003) emphasises, the many different current definitions, with modern interpretations of the word changing all the time, make it extremely difficult for educationalists to understand and be conceptually clear about 'curriculum'. It is perhaps easiest to identify the different levels of curriculum and then develop a definition from this point. Van den Akker sees four different levels of curriculum: the *macro* level (a whole system, society or nation's ideology towards the subject); *meso* level (an individual school or group of schools); *micro* level (in the classroom or in a specific subject within the curriculum as a whole) and finally the *nano* level (that of the individual). Van den Akker believes that these terms clarify the definition, because they acknowledge the different definitions at different levels.

From the previous argument it is clear that there is no specific definition of 'curriculum' and as Marsh notes (2009), writers naturally formulate a definition of the curriculum in line with their research. This current research therefore needs to define the curriculum for itself, as 'all the diverse learning and experiences with instructional tools under the guidance of the school and the teachers, given to students to help them lead lives which will build their country and the world'. The components of the curriculum include content, aims and objectives, learning activities, instructional tools and assessment.

### 3.2.2 Importance of a curriculum

The importance of having a curriculum to guide teaching and learning activities is debated and agreed by many studies. First and foremost, it has become quite obvious that 'the curriculum lies at the heart of education' and 'its grand design is a matter of great consequence' (Toombs & Tierney, 1993, p. 186). A curriculum generally consists of a selection of what is deemed important for learners to know. A curriculum is also important in giving students a sense of national identity (Tsolidis, 2011) through links to cultural and traditional customs via related content. Curricula are also used as a political tool to help shape society (Crawford, 1998). Thus, in addition to the formal knowledge gained through a curriculum, students also learn social norms and values through its more covert and subtle elements. These are ''the unwritten social rules and expectations of behaviour that are often not taught directly but are assumed to be known'' (Su, 2012, p. 155). Such almost subconscious lessons prepare students for their future life as citizens. Thus, the importance of a curriculum in developing economies and in reinforcing culture and beliefs should not be underestimated.

The curriculum is of importance to teachers because it offers them a structure to follow that incorporates ideas and teaching strategies or activities which help them meet the aims set for student progress and achievement. The verb 'run' usually denotes making fast progress. The absence of a curriculum could leave teachers doubting whether or not students had absorbed enough to move to the next level of study or meet its goals. This is summarised by the purposes of the Qualifications and Curriculum Development Agency (QCDA) in England and Northern Ireland, which maintains and develops the national curriculum and associated assessments, tests and examinations. The QCDA indicates that the importance of curriculum is to promote continuity and coherence, which they say allows children to move smoothly between schools and phases of their education; has instituted standards of performance recognised by students, parents, teachers, governors and the wider public; and provides a foundation for lifelong learning (QCDA, 2010).

Science has always held a high status in the hierarchy of school subjects, due to the contribution to a country's progress and development made by scientific work and discoveries. Furthermore, in order 'to maintain and develop the technical infrastructure on which we increasingly depend and to ensure national security and economic prosperity in the future, we need the education system to provide a steady flow of students into high-level jobs that require advanced scientific knowledge and expertise' (Millar, 2011, p. 174). In terms of learning, science is linked to investigative work known to develop critical faculties, which are intellectually highly valued. Historically, reforms to the science curriculum have tried to make the subject more accessible to all students, regardless of ability (Donnelly & Ryder, 2011), yet high level science is still essentially accessible only to the most able. The importance of science is also reflected in its share of the school curriculum, as Millar notes (2011). Many subject groups lobby for a greater curriculum share and ''in the case of science, these groups are particularly powerful because of its perceived link to national security and economic prosperity and its relationship to significant areas of activity such as medicine'' (Millar, 2011, p. 173).

A clear curriculum is beneficial to students because it offers a structure and order that they can follow, with greatly increased chances of achieving a specific outcome. Without a clear knowledge of what to study and in what order, students would have very little chance of achieving anything worthwhile. It is established that if the aims of education are to be met effectively, then it must naturally follow a structure that will allow for goals, activities and progress to be clearly set out, followed and evaluated. An effective curriculum is the means by which this can be accomplished and therefore is of great significance. One function of the curriculum is to turn attention to the necessity of its own reform and development, which are discussed later in this chapter.

### 3.2.3 Components of the curriculum

Curriculum components have been addressed in different ways, with the aim of exploring them comparatively. We may start by classifying them as previous studies do, for example, Lunenburg (2011) who divides the curriculum into three key areas: objectives, considered as the road map of where the objectives are; content or subject matter, answering the question 'what is taught?'; and learning experiences, answering the question 'how is it taught?'. Moreover, Rasinen (2003) believes that a curriculum comprises six components: content, general objectives, specific objectives, curriculum materials, transactions and finally the results. Nulty (2012) finds three key curriculum components: goals, learning activities and the assessment of learning outcomes, while Walker (2003) discerns three main curriculum components: the content, purpose and organisation of learning.

While it is clear that there are different views about the curriculum components, there is almost consensus that the two main ones are the aims and content, together with other components related to them. This is discussed by van den Akker, Fasoglio and Mulder (2010), who say: 'curriculum design and implementation experiences have taught us that it is wise to pay explicit attention to a more elaborated list of components' (p. 7). Others, such as Eash (1991); Klein (1991); van den Akker et al, (2009), indicate that the components of the curriculum are its aims and content, rationale, learning activities, teachers' role, materials and resources, grouping, location, time and assessment (Figure 3.1). These are the components on which this study focuses. To clarify the relationship between the various aspects, consider what is called the 'curricular spider web' (Figure 3.1) (Van den Akker, 2003). ''The rationale serves as a central link, connecting all other curriculum components. Ideally, these are also connected to each other, providing consistency and coherence.'' (Thijs & van den Akker, 2009, p. 12)

The science curriculum reform process in Kuwait, discussed in detail in the previous chapter, suggests that the MoE's reform process included many of the above curriculum components, such as the aims, content, learning activities, assessment and instructional tools. Thus it may be useful to discuss these components to provide some background knowledge.

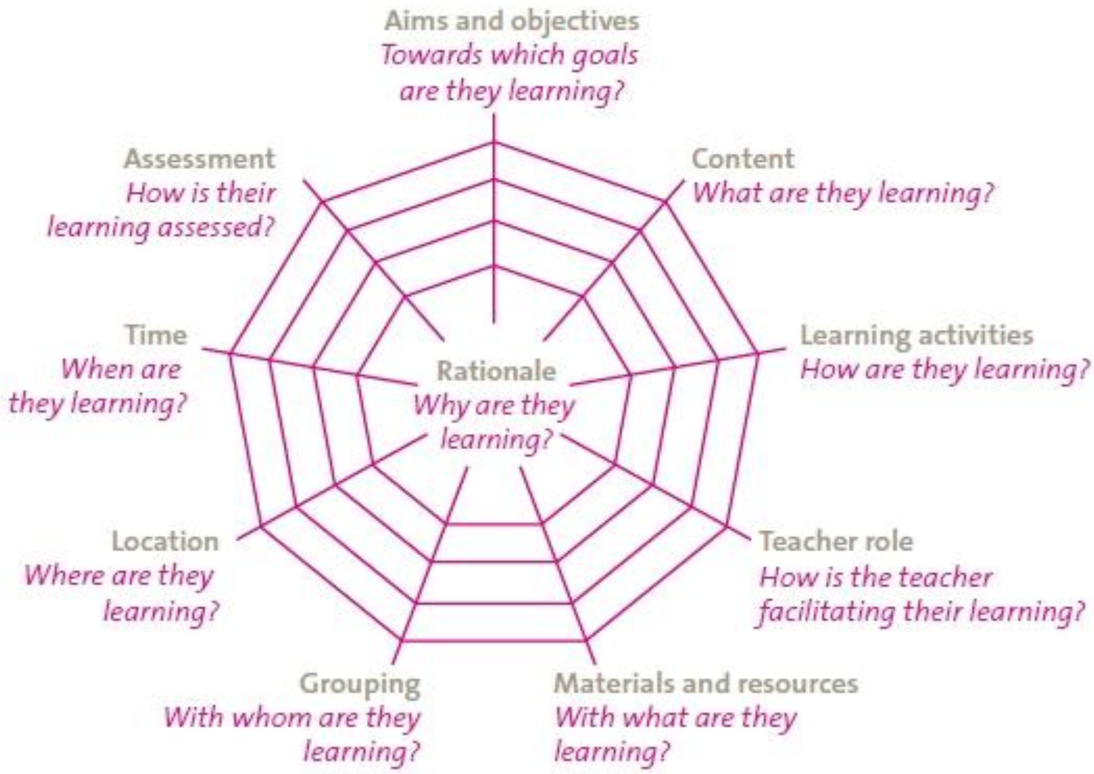



**Figure 3.1** The curriculum spider web (van den Akker 2003).

### 3.2.3.1 Aims and Objectives

Objectives help to state what students are to learn through instruction (Salamah, 2012). Other terms used instead are outcomes, goals, aims, purpose and intentions (Marsh, 2009), but 'objective' is the word that I will use throughout. According to Bramall and White (2000) 'good aims' are vital for a good curriculum. They add that the social culture of the students must be taken into account when choosing and design the curriculum aims. This may have an impact on what students learn and even *how* they learn. Even more importantly, it is pertinent that objectives be stated clearly, have an outcome and are measurable. The curriculum is more attainable and effective when objectives are stated clearly. Objectives that are clear and specific describe precisely what is expected of the learner (Anderson & Krathwohl, 2001). According to Reiss and White (2013), an aims-based curriculum is what schools should support.

Two overarching aims, to their mind, are to enable each student to lead a life that is personally flourishing, and to help others to do so, too.

The main objectives of the science curriculum are to develop in the students' minds an interest and inquisitiveness about the world; a knowledge and understanding of scientific ideas; an ability to apply scientific knowledge, observe and ask questions in everyday life; competence in the use of the knowledge and methods of science; critical awareness of the role of science in everyday life, and the ability and confidence to use problem-solving methods systematically by creative thinking (Kesidou & Roseman, 2002).

In addition, Braund and Reiss (2006) indicate the following six aims of science education: *preparing a supply* of future scientists; *securing scientific literacy,* by understanding key ideas about the nature and practice of science as well as some of its central conclusions; *individual benefit* to the students in everyday life and enhanced understanding of technology; *democracy,* from learning to listen to different points of view, leading to research, exploration and conclusions; *social justice* or social-political action, from scientific contributions to the happiness of all and the improvement to people's lives; finally, *criticality,* the skill of critical thinking through the exchange of views and discussions with teachers and other students.

In this study and as discussed in Chapter Two, one of the aims is to explore the views of the teachers, students and the reformers who worked to reform the science curriculum about the new objectives which the reform also covered.

#### 3.2.3.2 Content

Generally, the content of the curriculum is the structure of its concepts and the process of transmitting it, which concentrate not only on a number of subjects, but also on lesson plans, course outlines and every proposed topic for a coherent mixture, in which the whole curriculum needs internal coherence in all its components in order for it to work seamlessly. According to the American Association for the Advancement of Science (AAAS) which is an international non-profit organisation dedicated to advancing science for the benefit of all, the contents of the different topics work towards specific goals, disciplines and integrated organisation (AAAS, 2000).

The content of the science curriculum has to relate to the students' everyday life, social culture, social needs and environment. Many studies take this view, including Branud and Reiss (2006) and Reiss (2002) who say that if it does it will contribute to making the students' attitude toward science more positive and more satisfying. Yilmaz et al. (2004) make the same point, adding that it will also give them more positive attitudes toward environmental issues. Also the science curriculum content should relate to the students' culture, while equally the social culture should take in the content of the science curriculum. This is discussed by Fortus, et,al. (2004) who contend that the curriculum content should be developed according to students' needs, abilities and culture. In Vygotsky's (1987) work about the socio-cultural theory he asserted that the student is not independent from culture; he/she is embedded in the cultural context, and that cognitive development depends on the social-culture of the students, so it is important to relate the curriculum content with the student's culture and daily life.

Salamah (2012) broadly agrees; in addition, Murray & Reiss (2005) recommend that the ''science curriculum should cover fewer topics to allow for more in-depth treatment and for more detailed explanations'' (p. 9).

From the above discussion, the importance of relating the content of the science curriculum to the students' everyday life, needs, culture and environment is clear. This study investigates the way in which the content was reformed in Kuwait and what teachers and students thought about its relevance to their social-cultural aspects.

#### 3.2.3.3 Assessment

The function of assessment is to explore how far the aims of a curriculum are achieved (Salamah, 2012). ''Teachers also use assessment informally in the classroom to judge what progress pupils have made with their understanding and to provide information on how they can be helped to move forward.'' (Mansell et al., 2009. p. 4)

Assessment is a method of providing feedback to several stakeholders in the education system and sharing the expectations of that system with all who are interested. Recently, the goals of science education have concentrated on connecting science to a wider social context, but in practice assessment has to measure this change (Orpwood, 2001). Data produced throughout the process of assessment give the students' feedback on how well class expectations were recognised and teachers' feedback on how probable it was that students gained knowledge and learned. The importance of assessment appears in allowing teachers to gauge the effectiveness of the educational strategies used in the teaching process. Consequently, effective assessment practices can enforce equally the instructional strategies employed by the teachers and the learning strategies that could be used by students (Orpwood, 2001).

Furthermore, assessment is considered an essential part of teaching and learning, as much in science as in other areas of the curriculum. The wide range of formative and summative assessment methods is described by Mansell et al. (2009): ''Formative [covers] the use of day-to-day, often informal, assessments to explore pupils' understanding so that the teacher can best decide how to help them to develop that understanding. Summative [covers] the more formal summing-up of a pupil's progress that can then be used for purposes ranging from providing information to parents to certification as part of a formal examination course.'' (p. 9)

Shin et al. (2009) indicate that the formative method may use discussion and questions, while the summative method allows teachers to collect rich information and more than superficial feedback about student learning. During their periods of instruction, students are encouraged to add up their experiences and data by yielding both oral and written explanations; implanted assessment lets students reveal their emerging understanding, in homework assignments, storyboards and lab reports to present direct evidence of learning. According to Al-Balushi & Griffiths (2013), a wide range of assessment methods, such as short written or oral tests, quizzes, assessment tasks, projects, portfolio work and student self-assessment not only help to provide a more accurate picture of students' attainments and needs and increase reliability but also achieve a better match between assessments and what has been taught and learned in the classroom, thus giving greater validity to the assessment system.

As noted in Chapter Two, it is clear that the student assessment system in Kuwait depended on the written exam, which obliged the students to memorise information, as confirmed by Galal (2013). Evidently, the assessment process is important and should be undertaken with a wide range of methods. Teachers and students were asked in the current study about their views of the assessment system in the reformed (new) curriculum to explore how it affected the teaching and learning of science and what modes of assessment the students preferred.

### 3.2.3.4 Learning activities

Learning activities are an important component of the curriculum for achieving the curriculum aims and teaching its content (Salamah, 2012). Learning activities refers to the type of instruction provided by the teacher or other executants of the curriculum. Lectures, discussions, discovery-based instruction and cooperative instruction are just a few examples of learning activities (Kali et al., 2008). A wide range of learning activities have been encouraged for use in science classrooms; Murray & Reiss (2005) discuss some of the effective and enjoyable ways of learning such as field trips, scientific experiments, discussions and practical work. In addition, Braund & Reiss (2006) note the value of relating what the students learn in the science classroom with the world outside because this will improve the learning of science and help students to learn science better and to enjoy it more. Braund and Reiss list three aspects of the beyond-the-classroom world from which students can learn: the actual world (e.g. as accessed by fieldtrips and other visits to see science in action); the presented world (e.g. in science museums, botanic gardens and zoos); and the virtual world (e.g. through simulations). Cooperative learning is another effective learning method, whereby students help each other on a task and learn by discussion with each other and the teacher (Zakaria & Iksan, 2007). Vygotsky (1987) indicated that students learn and understand easily by social interaction and cooperation between teacher and students and between student and peers in the classroom. Diversity in learning activities in the classroom makes an important contribution to improving the students' attitude to learning (Ni et al., 2011; Voogt et al., 2011). These two studies suggest that varying the learning activities has a positive effect. In addition, BouJaoude and Gholam (2013) recommend science learning activities which are responsive to the different needs of students in a heterogeneous classroom.

In this present study, classroom observation was used to explore the learning activities in use in science classrooms in Kuwait and what the teachers and students thought of them.

### 3.2.3.5 Instructional tools

Instructional tools can be used to help ensure that the curriculum is taught effectively. In the past educators considered instructional tools to be ancillary, but when the topics and subjects of the lesson become more complicated, students need more help in interpreting information and getting information from libraries, government documents and computer databases or from experts from industry, the community and government (Kesidou and Roseman, 2002). With the passing of time, more tools to help science education have been designed for the more effective implementation of an inquiry-based approach. The value of using tools in science is now well known; they help to illustrate and develop a deeper understanding of phenomena or scientific concepts and also help by arousing students' interest, raising achievement and creativity in learning and developing innovation. Video, film, laboratory and computer simulations are all useful in making observations, conducting experiments and going on field trips (Berliner, 2002). Using ICT facilities such as videos, computers, smart boards and so on makes learning science easier, quicker and richer (Boohan, 2002; Harlen, 1999). A study by Braund and Reiss (2006) states that the purpose of using instructional tools such as virtual reality simulations in teaching science is because this helps to connect the students with what they are learning and will contribute to a better attitude to science. In addition, Ferreira, Baptista and Arroio (2013) state that such multimedia tools as animations, simulations, interactive games, lab simulations and videos provide useful communication, strong verbal messages and memorable images and make science lessons more interesting. Manuguerra and Petocz (2011) and Meurant (2010) discuss the use of iPads as instructional tools, emphasizing that this has a positive impact on students' learning attitudes and makes the experience of class and school more enjoyable.

In addition, Vygotsky indicated that instructional tools play a main role in building knowledge and he believed that the human capacity for change and development enables people to use tools to solve difficult natural problems, or in other words, to use them as mediators (Vygotsky, 1987). Vygotsky found that cognition is rooted in verbal and non-verbal exchanges. He 'primarily emphasised symbolic tools, mediators appropriated by children in the context of particular social activities, the most important of which he considered to be formal education' (Kozulin et al., 2003, p.17). Vygotsky (1987) asserted that the tools are produced by the socio-cultural development of individuals and used to see concepts from the perspective of the learner to provide him with ways of knowledge, including writing and drawing and dialogue - verbal symbols and signs, ideas, beliefs and language. The instructional tools are factors assisting the learner to understand knowledge but must be used correctly under the guidance of the teacher (Scott & Palinscar, 2009). This shows the importance of instructional tools as mediators in obtaining knowledge and raising learners' cognitive level.

The above argument about instructional tools shows that using instructional tools is important and useful for teachers including science teachers and has a positive effect on students' attitudes toward science and building knowledge. In this study, classroom observation was used to observe the instructional tools current in science classrooms in Kuwait and teachers and students were asked which tools were available and effective in teaching and learning and what they thought of them.

### 3.3 Science curriculum reform

To reform means to make different, reshape or reconfigure, but simple change does not always mean improvement (Schubert, 1993). The reformers in the present study had to identify the content and scope of the new curriculum and to understand the students for whom the curriculum was intended. Reform also needs a supporting structure in its processes, the teachers and administrators who would implement the reform within the schools. A curriculum reform must involve the content, modes of instruction, teacher education, student assessment and related research (Shymansky & Kyle, 1992).

The development of science and the manner in which it is taught in schools have come under increased scrutiny in the twenty-first century. The need for curriculum reform in science has been specified by many experts and practitioners in the field, coinciding with the desire to overhaul curricula more generally within the system.

Before identifying how science curriculum can be reformed and the need for this change, it is important to understand the term ‘curriculum reform’. A traditional view of curriculum development acknowledges that curriculum reform occurs through an assessment of its contemporary relevance to ‘nationally defined needs’ as well as the changing political control of the national government (Skilbeck, 1990, p. 35). Moreover, it is noted that the concept of curriculum reform has been ‘‘regarded as an essential strategy for educational reform’’ (Hopkins, 2008, p. 169).

### 3.3.1 Need for science curriculum reform

Regarding the nature of this curriculum reform, a number of studies have commented on the need for reform from the perspective of the subject of science. In one study by Ryder and Banner (2011) about the reform aims of national curriculum reform for science in England, they underlined that one of the greatest needs for a reform was the chance to improve scientific literacy, which the authors described as ‘‘an increasingly prominent aim for school science education’’ (p. 709). The importance of scientific literacy cannot be understated. It is stressed in a later work by Ryder and Banner (2013) that the reform was introduced to ‘‘enhance the range of available science courses and emphasise the teaching of socio-scientific issues and the nature of science, alongside the teaching of canonical science knowledge’’ (p. 490). This integration of science within society and the education system reflects the delicate balance required in terms of content knowledge and the socio-economic developments taking place in society in the twenty-first century.

Another argument provided in the literature for the need of a reformed science curriculum refers to the more general development of individual students. In article by Toplis, Golabek and Cleaves (2010) about the new science curriculum in England, they state that there was need for a reform that would address the issues of ‘‘engagement in higher order thinking skills’ and argued that ‘the importance of [student] differentiation is paramount if all pupils are to connect with the new curriculum’’ (p. 65). This view suggests that students need to increase not only their content knowledge (which was a strong focus of the previous curriculum) but also the ability to apply this knowledge in alignment with the direction in which society is moving. Furthermore, there should be a focus on the differentiation of students so that they can all achieve to the limits of their ability, rather than attempting to increase the skills of all students in a general way. Smith (2010a) comments that the ‘‘perceived quality of science teaching has existed since science was introduced as a school subject… raising issues about the role of policy in influencing educational change more generally’’ (p. 189). Smith’s analysis of the previous curriculum identifies three main themes; his assessment underlines the fact that, on top of specific changes to the science curriculum, there was also a broader concern with the more general impact of curriculum development and reform overall, asking whether government intervention actually had the required effect at local and national level.

One of the other reasons for reform of the science curriculum is that the previous one did not cover the effects of globalisation. Globalisation may be defined as a multi-way process involving flows of ideas, ideologies, people, goods, images, messages, technologies and techniques (Hismanoglu, 2012). Globalisation and technological advance have challenged all dimensions of human life and all social systems, not least the educational system and at its core, curriculum. In addition, they have strikingly changed our ways of learning and teaching in the twenty-first century (Hismanoglu, 2012).

The effect of globalisation in education is to stimulate the dissemination of knowledge and the practice of ‘open innovation’ activates the innovation processes (Mingaleva and Mirskikh, 2012). Knowledge develops through both collective and individual learning processes and grows through interaction, information, local knowledge, human capital and research. Innovation is considered to be basic to any curriculum development, but the science curriculum in particular. As a country moves towards globalisation the present generation should be prepared with every possible form of knowledge and skills. Thus, improving the science curriculum will raise the ability of the students, improve their academic success and prepare them better to absorb scientific knowledge. Meador (2003) notes that scientists can categorise creative problems which are not recognised by others, but not all students will become scientists. Still, aspects of the science curriculum, such as skill in the scientific process, are very important for encouraging creative thinking and thus developing students’ potential and opening opportunities for them as scientific professionals.

Other reasons for reforming the curriculum include the failure of the previous one to increase students' engagement with the subject. One example of this can be found in the introduction of the *How Science Works* (HSW) element of curriculum reform which was introduced in England in 2006. An article published by Jenkins (2013) claims that, although well intentioned, the introduction of HSW led to a much lower level of science knowledge and content than necessary being taught in English secondary schools, specifically to make room for HSW, which focused on the philosophy underpinning science. In Jenkins' opinion, this detracted from students' learning and meant that they were being failed in terms of scientific knowledge. The aim of HSW was benign – to divide the school population into those who wanted to follow a career in science and those who needed to learn the subject for the sake of being a well-informed citizen. This division, however, led to the view subscribed to by Toplis and Golabek (2010) that the implementation of HSW caused controversy, confusion and an inability to increase student knowledge and engagement sufficiently within the teaching of the subject. This one example reflects how much science reform worldwide needs to constantly update itself and address possible shortcomings in its effect on students.

These findings underline the great need to reform and improve science curricula to meet the demands of society, through improvements to the education system and changes in the approach to (and importance of) technology and the globalisation of world markets. The need to reform the process of science curriculum reform in Kuwait is discussed among the findings of this study.

### 3.3.2 Teachers' role in curriculum reform

Many writers discuss the teachers' role in curriculum reform and the importance of involving them when curriculum reform is planned. Schwab's (1969) early work introduced the notion of a socio-cultural approach to curriculum design. He ''maintained that no curriculum deliberation would be adequate without teacher participation'' (Saha & Dworkin, 2009, p. 62). His work focuses on the important role that teachers and students play in the reform and development of the curriculum. In this sense, Schwab has been described as the ''first educational theorist to call close attention to the lived experiences of children and teachers in classrooms'' (Elbaz-

Luwisch, 2006, p. 359). This relatively early analysis of curriculum design within a socio-cultural approach paved the way for increasing numbers of such studies in education. The importance of the social and cultural context is demonstrated by the example of the physics curriculum in New Zealand, which was said to lack an inter-subjective connection between the teachers and the curriculum designers because of a failure to plan for teachers' participation in the curriculum negotiations (Fernandez, Ritchie and Barker, 2008). Keys and Bryan (2001) proposed a need for more social research on aspects of students' learning and teachers' knowledge, beliefs and practices. Since the effectiveness of reform efforts relies greatly on teachers, it is important to include their participation in the design process, in which the social and cultural context of the entire education system must be considered.

The results of Handler's study (2010) of teachers as curriculum leaders indicate that the better qualified they are, the more they will engage in the planning and development of the curriculum. Where they teach may also affect their involvement; thus rural teachers are rather less likely to engage in curricular decision-making than their urban counterparts. In addition, the gap between most teachers' actual role in curriculum reform and their aspiration to be involved in its process suggests a substantial mismatch between teachers' own beliefs, values, ideas and views and the involvement assigned to them by the policies of the policy-makers (Handler, 2010) .

Van den Akker (2003) agrees that teachers must participate in the curricular reform process and have their views on it considered. He foresees many problems entangling decision-makers in the process of reforming the curriculum which may cause it to fail, including, without being limited to, the following: 1) setting goals which are difficult to attain in practice; and 2) limiting the reform process to a certain group of decision-makers without the involvement of teachers and the provision of the training tools that they need to tackle the new curriculum (Van den Akker, 2003).

This matter is stressed by Zellaman, et al., (2009), who recommend that curricular improvement and teaching plan development should not be carried out by the MoE alone, because the decision-makers will control it and hinder the process of reform. Teachers must be given an opportunity to participate in curriculum reform and the development of appropriate teaching plans. Dillon (2009) believes that most curriculum reforms do not succeed because they do not discuss the difficulties that teachers face and that this is a result of not involving the teachers in the curriculum reform process. He concluded that involving the teachers in any curriculum reform is a condition to the success of this reform process. This point is argued in depth by Ryder (2014) in his work about teachers' experiences of external science curriculum reform and focuses on teachers who did not participate in the science curriculum reform process. He mentions that ''the science curriculum undergoes repeated reform in many countries. However, it is often reported that the enactment of such reforms within schools rarely reflects the intended outcomes of curriculum designers'' (p. 1). Ryder concluded that science curriculum reform will fail if teachers do not participate because many teachers will not enact a reformed curriculum as intended by developers, and this is the result of insufficient teacher knowledge and/or skills concerning the reform. He recommended that any science curriculum reform must to take into account the teachers' ''personal beliefs and knowledge, also internal features of their school workplace (students, teacher peers, school management) and contexts external to the school (district, state, national educational policies; parental pressures, high stakes testing, school/teacher accountability measures).'' (p. 19) Woodbury and Gress-Newsom (2002) agree that the reform process cannot succeed without the direct involvement of teachers and that leaving them out will negatively affect teacher attitude toward teaching this new curriculum. The relationship between teacher attitude and students' attitude is argued by Prokop et al, (2007) in their study about Slovakian students' attitudes toward biology. They concluded that teacher characteristics and attitudes toward biology were found to have a significant role on Slovakian students' attitudes toward biology, because the students take the biology teacher as a model for deciding about their career. But their views about teachers differ according to different teachers. Thus, the individual character and attitude of a teacher may be important issues for their effect on student attitude. The teacher is the cornerstone for any successful reform process in education, in particular curriculum reform (Battista 1994, Bullough & Boughman 1997, Pajares 1997). But the curriculum is reformed, as described in the study of Orafi and Borg (2009), through a process administered by many public and private committees. They focus on the pedagogical practices which support the reform and the extent to which these are aligned with teachers' current practices and beliefs. Even though Dillon (2009) in his study of scientific literacy and curriculum reform pointed out the importance of the role that teachers can play in the success of curriculum reform, it is worth mentioning that teachers are rarely involved in decision making within the educational setting and if they do take part, their role is usually as observers.

To focus more closely on the concerns of this thesis, Melville (2009) identifies that the process of science curriculum reform seeks to start by developing teachers into well-prepared educational staff with whom the reformers must continuously get in touch. This would fill the gap between reformers and teachers. In addition, Dillon (2009) suspects that science teachers do not always share the same views about building a well-formed curriculum to be delivered to students or about the nature of science. Thus, the involvement of different teachers in the process of curriculum reform is important for negotiating a common set of beliefs about the ideal way of creating the reform (Melville, 2009). The American Association for the Advancement of Science (AAAS) noted in 1994 that teachers will encounter major problems in teaching curriculum content if they have not been prepared properly for it or have not been given adequate information on the curriculum approach, or have not taken part in planning it. Hence, the participation of the teacher in the curriculum reform process is critical (AAAS, 1994).

All these sources indicate that it is important to involve teachers in any educational reform, including that of the curriculum, because this determines its success. However, as the discussion in Chapter Two illustrates, the reformers and policy-makers in Kuwait did not involve teachers in any decision-making concerning the reform of the science curriculum. To discuss the role of teachers in education reform in general, and curricular reform in particular, I discuss this topic through the previously mentioned studies of Haidar (2000), Rugh (2002) and Al- Momani et al. (2008), who agree that the main role for teachers in most Arab states is to deliver the curriculum according to a course plan already developed by the MoE and to implement whatever is being requested by its officials. They also confirm the situation described above of the teachers' lack of autonomy.

Al-Daami and Wallace (2007) note the absence of any role in decision-making for teachers in Jordan, along with many other Arab countries, and that most curricula were designed by a group of policy-makers without any role for teachers. The task of mediating centrally-devised curricula to students in classrooms is faced by all teachers; problems with teaching the new curriculum are intended to be alleviated by sending - as was mentioned above - official curricular guidelines that were reviewed by policy-makers from the MoE for each subject, with direct orders concerning when and how each part of the material will be taught. Shaw (2006) contends that in most Arabic countries including Kuwait, the teacher's role is limited to teaching the curriculum content to students according to the Ministry's teaching plan within a specific timeframe, and that in most Arabic countries the teacher is not involved at any stage of the reform process (Shaw, 2006).

Mansour (2011) confirms that the Arab states are not interested in engaging the teacher in the process of education reform. He believes that the decision-makers should involve the teacher in the process of education reform and the development of education policies.

### 3.3.3 Students' role in the curriculum reform

Schools have been constructed as places for students' education, curricula have been developed for their learning and teachers are appointed to teach them. Their central place in education should be beyond dispute. It is believed by Manefield et al. (2007) that listening to the students' voice and exploring their opinions is essential before beginning the preparation and development of a curriculum because their point of view should be foundation of the reform process.

It is confirmed by Waldrip and Taylor (1999) that the opinions and views of the students should be explored when a curriculum is designed and developed. They state that the students' views are so important in the successful process of curriculum development that listening to the students will help to relate it more closely to the students' everyday life and culture.

In their review of the role of students in curricular development, Leat and Reid (2012), state that consideration of the students' views and their participation in any curriculum reform process will assist the decision-makers and those who are concerned with the reform process to shape their work to students' needs, which helps the planners to work out how to reform the curriculum and makes the process successful.

Some studies have gone beyond these perspectives, believing that to leave students out of the process of curriculum reform and not listen to them condemns the process to failure. Levin (2000) in his study of the role of the student in education reform says, ‘‘Education reform cannot succeed and should not proceed without much more direct involvement of [the] student in all its aspects’’(p. 155). He stresses that any process of education reform, including the process of reforming the curriculum, which does not take student opinion into account will encounter problems in the future and he considers it non-comprehensive because it has not taken into consideration the views and needs of the students. Moreover, some believe that listening to the students and involving them in the curricular reform and development process will not only contribute to the success of these processes but will also produce other benefits.

Manefield et al. (2007) are convinced that involving students in the development of education and listening to their views encourages their participation and discussion. This creates a feeling within the students that they are part of the educational process and enhances their confidence in themselves, which is reflected positively in their education and understanding of the lessons.

In his study, Jackson (2005) stresses the same point: that giving students the opportunity to be heard in matters relating to the development of education will give the students confidence in themselves and encourages them to learn and love school. Thus, the students will feel that their voice is listened to and that they are participating in the decision-making in the development of education.

As Spackmen (1991) says, the involvement of students in educational reform is also achieved by understanding the student-teacher and student-school relationship. Appreciating this relationship is important because the more positive it is, the more the students’ love of study increases and is positively reflected in their understanding of the lessons. Listening to the student also possibly contributes to finding appropriate solutions for their problems in school.

Many studies, as mentioned earlier in this chapter, have emphasised the importance of linking curricula, not least the science curriculum, to the culture, religion and environment of the society in which the students life and to their everyday lives in helping them solve problems.

In England, where the opinions of 350 students aged 16-19 were explored through interviews and questionnaires, Cerini, Murray and Reiss (2003) found that the students' views on the science curriculum revealed its strengths and weaknesses. Knowing the students' views, if the developers of the curriculum can identify the needs of the students, then they can modify the curriculum to suit these needs and link it to their everyday lives. These writers add that a system should be ''put in place to ensure that decisions that affect students cannot be taken without taking student views into account'' (p.19).

In another study entitled 'Listening to pupils' by Reiss (2006) he highlights that it is important to listen to students so as to understand their needs and preferences in studying science, because relating the curriculum to the students' needs will contribute to their successful learning.

In addition, Aikenhead (1997) discussed the students' views and the influence of their culture on the science curriculum. He emphasised involving students in science curriculum reform and listening to their views because this will contribute to designing a new curriculum which is more relevant to them. This will help make the subject more accessible.

The science curriculum prepares students to meet future challenges and learn how to overcome them, so it is necessary to develop these curricula according to the students' needs, abilities and culture. This argument is highlighted by Fortus et al. (2004) who advocate for successful reform listening to the students and identifying both their needs and what they want to learn, what they learn now, how they want to learn and what difficulties they face because these things will contribute to the process.

The foregoing examples illustrate that it is crucial for the success of curriculum reform and development to get the students involved. However, the students' voices were ignored in the curricular reform in Kuwait. Moreover, the importance of the present study lies in the fact that the students have been involved in it; their views on the new science curriculum listened to; their needs and the difficulties they encounter in studying the new science curriculum identified; and whether the new science curriculum is linked to their needs and culture investigated.

### 3.4 Context of the science curriculum reform

Curriculum reform, including that of the science curriculum, takes place in many different contexts. In Lee's study (2003) evaluating the new science curriculum in Hong Kong, he discusses different aspects of the context of educational reforms, such as the political, economic, educational and socio-cultural contexts. Each of these contexts influences such reform (Lee, 2003). The present study focuses on the socio-cultural context and its influences on science curriculum reform, because this is an important consideration when reviewing curriculum reform.

There are two related theories which could have been used as a framework for this study, socio-cultural theory (SCT) and Activity theory (AT). Both originated in the work of the Russian psychologist Vygotsky, whose major period of productivity in Moscow was between 1924 and 1934 (Edwards & Daniels, 2004). These theories have more recently been brought together by researchers who recognize their complementarity and that they enrich each other as a unified set of concepts (Edwards & Daniels, 2004). Socio-cultural theory was chosen as the theoretical framework for this study in order to focus on the social-cultural context in which the new science curriculum was being implemented. This is discussed in detail in section, 3.4.1.

However, the potential value of using activity theory is clear since Kuutti (1996) asserts that:

> "Activity Theory and the concept of activity seem to be particularly suited to being used as the starting point in studying contextually embedded interactions" (p.37/8).

Waite (2005) makes a similar point when he states that:

> "AT illustrates how actions and processes are divided and shaped by the larger community that is involved in accomplishing a specific activity" (p.1).

Vygotsky's original formulation of an 'activity' involved considering the subject(s) involved in the activity, the object(s) of the activity and the mediating tools used to attain the object. Engestrom enriched this model by incorporating the concepts of 'community', 'division of labour' and 'rules' into the activity system. This 'second generation' activity theory was then developed into 'third generation' activity theory which can be used to enrich understanding of the interaction between two systems by providing 'conceptual tools to understand dialogue, multiple perspectives, and networks of interacting activity systems' (Engeström, 2001 p.135).

Further research on the synergies and tensions between the processes involved in the activity of curriculum reform and the impact this has on the activities of teaching and learning science could thus usefully be framed in terms of third generation activity theory. This is because the Ministry of Education (which reformed the science curriculum) and the schools (which are implementing the new science curriculum) can be conceived as being two interacting activity systems. These systems could be analysed to understand the object, subject, rules, community, division of labor and tools of each activity system. Use of third generation activity theory would help to understand the relationship between these two systems, how they work together and what the gaps are between them, in order to explore to what extent this relationship affects the teaching and learning of the new science curriculum.

### 3.4.1 Theoretical framework

In this study socio-cultural theory is used as a theoretical framework to help to understand the process of science curriculum reform and to understand in practice the processes of implementation (teaching and learning) the new science curriculum. Before discussing the role of culture and social assumptions as the theoretical framework of this study, the development of socio-cultural theory and the main principles and importance of the theory are given.

Social-cultural theory has its roots in the writings of the Russian psychologist Vygotsky and his contemporaries around 1917. He died in 1934 but some of his work was published in English in the 1970s and his collected works in 1987. Socio-cultural theory (SCT) indicates that human mental functioning is a mediated process that is coordinated through activities, concepts and cultural artifacts. At the same time, SCT contends that the most significant classes of human cognitive activity arise by interaction inside these social and material forms (Vygotsky, 1987). According to Scott & Palinscar (2009),

> *The work of socio-cultural theory is to explain how individual mental functioning is related to the cultural, institutional and historical context; hence, the focus of the socio-cultural perspective is on the roles that participation in social interactions and culturally organised activities play in influencing psychological development. (p. 1)*

The main theme of the theoretical framework of SCT is that social interaction plays a key role in the development of cognition. Awareness does not exist in the brain, but in daily practice; this hypothesis of Vygotsky formed a basis for work by Ryder (1998). The extent of the child's development of culture is shown twice, first in the level of social intercourse which appears between people (inter-psychological) and later at the individual level, which appears inside the child (intra-psychological) (Vygotsky, 1987). This point is discussed by Doolittle (1997) who indicates that with regard to SCT the knowledge comes through from the beginning of the social interaction between the learner and someone else more informative and is then adopted by an individual self as an activity. The scientific knowledge occurs on the social level and moves to the psychological level between inter-psychological (i.e. between children and their family, parents and environment) and then intra-psychological (working and talking about the knowledge and then trading it between the learner and others).

Vygotsky (1987) stressed that the growth of individual capabilities such as mental development, thinking and language occurs according to the culture and during social interactions with others. SCT suggests that there is a dynamic and interdependent relationship between everyday concepts and scientific concepts. Vygotsky indicates that everyday concepts and ideas are the basis of understanding scientific ideas and claims that the recurring concepts of everyday life make a series of structures necessary for the development and acquisition of scientific concepts. Furthermore, Vygotsky (1987) argues that scientific concepts should be presented to students by connecting them with everyday concepts, knowledge and familiar practical activities.

This interdependence, as argued by Bliss (1995) in a study of the teaching of science, indicates that SCT classifies the concepts of learners as either daily or spontaneous concepts (which are acquired through interactions and experiences out of school with culture of parents, family, friends and the surrounding society) or scientific concepts (which are acquired through mental processes in school). Bliss maintains that to transmit scientific concepts to learners, they should be related to the learners' daily concepts (spontaneous) by perceptible examples which are known and relevant to the learners' daily lives (Bliss, 1995). In addition Vygotsky notes regarding the SCT that students tend to link what they learn in school with their lives outside because this helps them to understand more easily (Vygotsky, 1987). Scott added that the scientific concepts can be easier to understand if they are linked with students' everyday lives (Scott, 1998). Furthermore, Ahn (2009) comments that the degree to which teachers link everyday concepts with scientific concepts is significant for the students' internalisation and thus necessary for the development of their concepts; therefore, the best way of teaching is one which takes everyday concepts and scientific concepts into consideration and links them to each other in a dynamic process (Ahn, 2009).

This shows that the SCT makes a point of the importance of bringing in students' everyday lives, culture and situation into the learning and understanding of scientific concepts and giving them a positive impact, therefore the relationship between scientific concepts and students' daily lives should be taken into account in reforming a science curriculum. In this present study this point is acknowledged by exploring the teachers' and students' views about the extent to which the new science curriculum takes into account the relationship between science content and the student's socio-cultural matrix. Using SCT as the theoretical framework for this study has helped in understanding this relationship and to shed light on the vision for developing and reforming the science curriculum.

In terms of cognitive development, teacher role and learning activities, Vygotsky's SCT introduces the constructs of the Zone of Current Development (ZCD) and Zone of Proximal Development (ZPD), which trace cognitive development through the process of teaching and learning activities. The ZPD refers to the difference between what a learner can achieve or learn individually (the ZCD) and what s/he can achieve or learn in co-operation with more capable peers or in collaboration with a teacher or mentor. Vygotsky defines the ZPD as:

*the distance between the actual development level as determined by independent problem-solving and the level of potential development as determined through problem-solving under adult guidance or in collaboration with more capable peers. (Vygotsky, 1978, p. 86).*

In other words, 'what the child is able to do in collaboration today, he will be able to do independently tomorrow' (Vygotsky, 1987, p. 211) (see Figure 3.2).

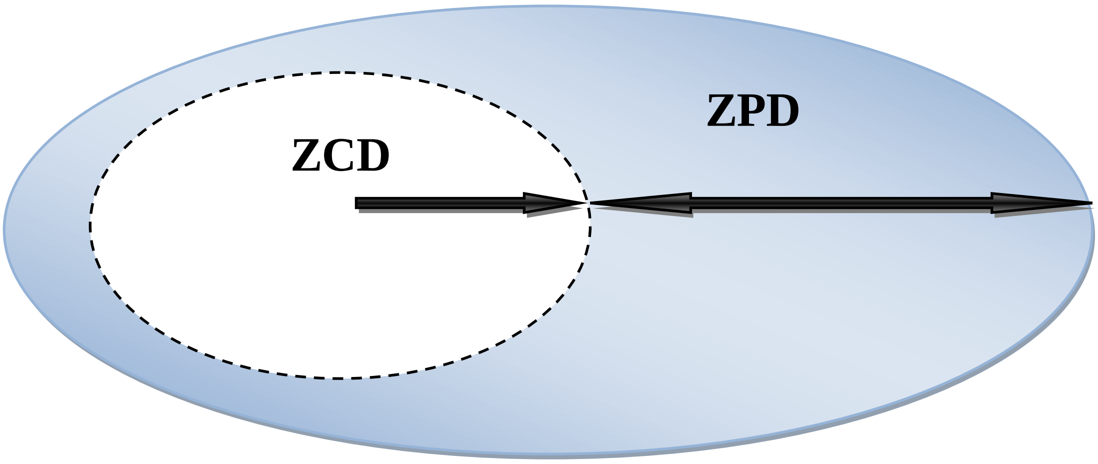



**Figure 3.2** ZCD expands to ZPD

In Figure 3.2, the zone of current development (ZCD) represents the level that a learner can reach individually and the ZPD is the potential distance the learner could reach with the help of a more capable peer. After successful instruction, the outer edge of the ZPD then defines the limits of the new ZCD (diagram adapted from Harland, 2003).

Harland (2003) discusses the ZPD in his study of problem-based learning. Harland concludes that using the ZPD as the theoretical foundation in teaching and learning activities helps students to develop autonomy in the context of collaborative learning and creating and maintaining an instructional environment centred on socially interactive methods. The cognitive in the ZPD is dynamic and constantly changing because what the learner can do today with some help, he or she will be doing tomorrow independently and, given the maximum support and assistance that they require today, can work with the help of less assistance tomorrow (Leong & Bodrova, 1998). For example, as mentioned by Bodrova & Leong (1998), ‘‘if today a child can write her name only when a teacher shows her how to form each letter, tomorrow the same child may need only initial prompting to finish the rest of [the] writing by herself’’(p. 3). This shows that the cognitive development level of the learner rises and the level of the assistance needed changes as their development changes; it also confirms that as the level of potential development moves ahead, the ZPD shifts (ibid) (see Figure 3.3).

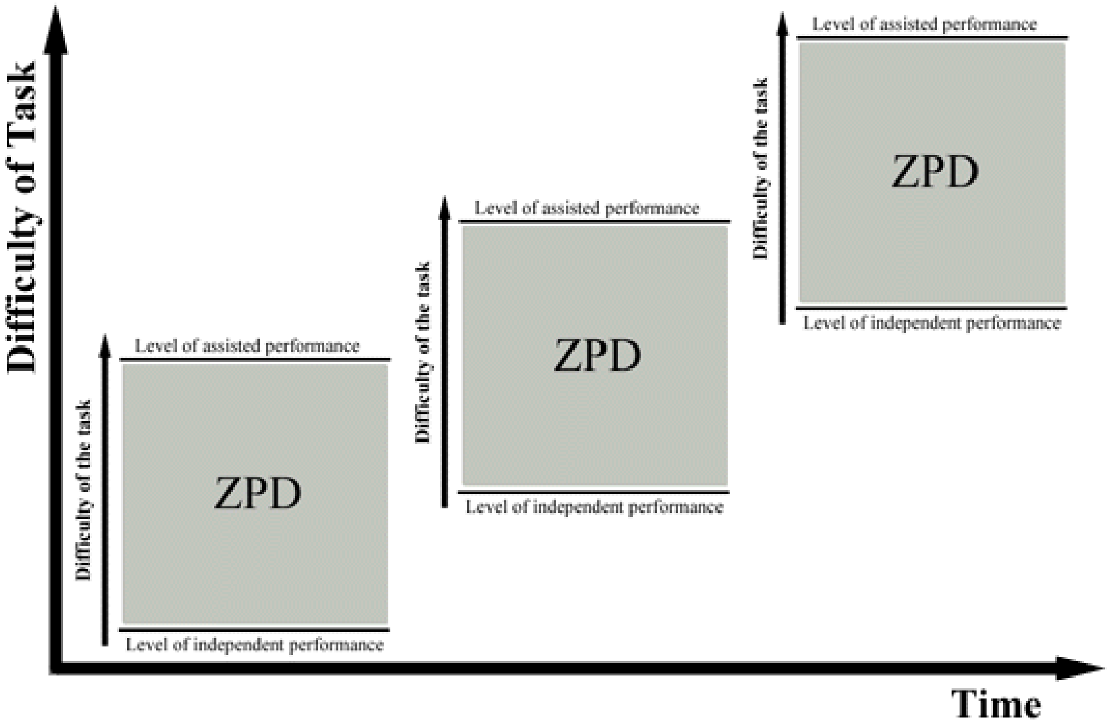



**Figure 3.3** Cognitive development level of the learner over time.(adapted from Bodrova & Leong,1998)

The cognitive development depends on the ZPD, which means that the level of cognitive development progresses when the learner engages in social activities (Chaiklin, 2003). That is, full development needs full social interaction if the extent of the skill that is completed by adult guidance or peer collaboration exceeds what can be accomplished alone (ibid). Rogoff (1990) writes, ‘‘Children's cognitive development is an apprenticeship - it occurs through guided participation in social activity with companions who support and stretch children's understanding of and skill in using the tools of the culture’’ (p. vii).

From the above argument the importance of SCT and ZPD in understanding cognitive development is clear; it shows that social interaction and cooperative activities are useful ways of teaching because they contribute to raising the cognitive level of the learner. This study may not focus on cognitive development directly, but it focuses on the teaching and learning activities which are used to teach and learn science in classroom, and I used the ZPD to understand these activities, together with the teacher's role. So the SCT and ZPD will help in discussing these activities and to explore to what extent the social interaction and cooperative activities are used in science classes at the Kuwait schools which were selected in this study; and also in understanding how the science curriculum is taught. This insight will be helpful in discussing the findings of this study.

The teaching and learning activities related to SCT are discussed by Wells (1999), who states that successful teaching depends on encouraging learners to use critical thinking and problem solving methods to attain knowledge by means of social interaction and cooperation between teacher and students and between students and their peers. This will affect positively the students' attitude to learning (Wells, 1999). Alexopoulou & Driver (1996) find the same, that social interaction is important to the learning process, through discussion between teacher and students and among students, to gain knowledge and develop the cognitive level. The nature of social interaction is not to separate learners from their society in the learning process but will immerse them through cooperative group activities between teacher and students and among groups of students (How, 1996).

Azmy (2006) takes a practical approach to teaching and learning activities relating to SCT. He describes the teaching activities in SCT as a way of teaching which depends on the distribution of learners in groups *(cooperative learning),* where the teacher begins to raise questions under the guidance of learners to assess what concepts and ideas suggest spontaneously and then asks the members of each group to negotiate with one another to reach the best definition of the target concept *(social interaction).* After the teacher has received these definitions, s/he works to modify or correct them by involving all the learners in a further search for improvements and employs this concept to solve problems in practice.

This draws attention to the teacher’s role in SCT, which is to assist and guide the students in their learning. The teaching process as defined in this theory is that of mediating and stimulating the students’ attention, directing and encouraging them to think about concepts in open discussion with one another. In addition, How (1996) reinforces the view that the teacher’s role in SCT is not to impose their opinion and ideas on the students, but to guide the learning process through discussion and cooperative activities. The teacher has to give the students the chance to present their ideas and discuss them with their peers, thus helping to build their confidence and increase their motivation to learn by social interaction and cooperative learning.

From the above argument it is clear that SCT is a useful framework in which to understand teaching and learning activities in the classroom and the teacher’s role in the learning process. The SCT demonstrates the importance of social interaction between teacher and learner and among learners in the process of teaching and learning. This study focuses on the important points of teaching and learning activities and the teacher’s and this is why using SCT as the study’s theoretical framework is helpful. It was used to help design some of the questions in the questionnaire and interviews and in preparing the aims of the observation.

From the previous argument it is clear that SCT is a comprehensive theory for understanding that in formal education, guidance and structure are provided to individuals by those more knowledgeable and that learning and cognitive development depend on social interaction and cooperative activities, and the and teacher’s role in the learning process.

This study is interested in exploring the views of teachers and students on the new science curriculum including the content, teaching/learning activities, instructional tools and methods of student assessment. In addition, one of the purposes of this study is to investigate the process of science curriculum reform and implementation. The new science curriculum was imported from the USA and adapted to suit the Kuwaiti students’ socio-cultural situation. In this respect, this study focuses from a socio-cultural perspective on the reform of the science curriculum and the relationship between teaching and learning science and its socio-cultural context. Using SCT as the theoretical framework in this study helped in understanding the reform process of the science curriculum and exploring teachers' and students' views about the new science curriculum. SCT is also helpful in understanding the curriculum adaptation process to make it suitable for the social-culture, daily life, and needs of Kuwaiti students. In addition, SCT is helpful in understanding the implementation of the new science curriculum in the classroom and the activities which are used for teaching and learning science. SCT was used in this study to guide the design of the research methods for collecting data (questionnaires, interviews and observation), by preparing questions which depended on SCT, which are discussed in detail in the Methodology chapter. It was also used in discussing the findings of this study to explain the participants' responses.

This section has focused on discussing the main principles of SCT and describing how it was used as the theoretical framework of the study. The next section focuses on the role of SCT in reforming and developing the science curriculum with regard to its socio-cultural context.

### 3.4.2 The socio-cultural context and science curriculum reform

The discussion of SCT in the previous section concluded with the importance of the social-culture and social interaction in developing students' cognitive level and its positive impact on students' attitude toward learning. This section discusses the science curriculum reform as based in the social-culture context. The process of science curriculum reform based in a certain socio-cultural context is discussed in many studies, all emphasizing that this context must be borne in mind in any curriculum reform process.

According to BouJaoude and Gholam (2013) ''The socio-cultural perspectives in science education emerged as important research areas which should be taken into account while designing curricula, teaching concepts and developing views about students' understandings'' (p.340). A study by Lemke (2001) indicated that the socio-cultural context of constructing and reforming a science curriculum means viewing science and science education as human social activities carried out within cultural and institutional contexts. A recent study by Mansour (2013) is about modelling the social-cultural contexts of science education. He indicated that socio-cultural theory can help in the reform of science education by giving prominence to teachers' beliefs and practices, which must be studied within a socio-cultural context. An essential challenge facing educational institutions is how to develop a technology-focused science curriculum which is aligned to the 'new approach' to science education based on international demand, whilst meeting the cultural assumptions of teachers and students; this is where the socio-cultural background to viewing the science curriculum must play a part (Mansour, 2013).

Many authors maintain that the relationship of the science curriculum to the cultural environment is essential and some state that the aims of the curriculum may not be achieved if it is irrelevant to the culture of the society. In this respect, van den Akker (2003) recommends connecting the curriculum to the students' society and culture, because it is important to the success any curriculum reform, while Fullan (2007) affirms the same.

In Waldrip and Taylor's study (1999) of the permeability of students' worldviews to their school views in non-Western developing countries, they stress the significance of taking the student's culture into account when the science curriculum is designed or reformed. They found that the local culture of the students greatly affected their learning of science subjects and that this culture is relevant to life outside the school. Absorbing the content of a curriculum which is relevant to the students' lives is more beneficial to them (Waldrip and Taylor, 1999). Reiss, too, notes (2002) in his study about reforming science education in the light of pupil views, that it is important to relate the science being taught to the students' social culture, needs and their everyday life, because this will help to make the science more satisfying for them. Another benefit for reforming the science curriculum regarding to the social–culture context is argued by Gilbert (2010), in his study about the culturally based science curriculum. Gilbert concluded that culturally based science curriculum may not only improve student academic achievement in science education and other content areas, but also change the students' attitudes in a positive way toward science.

Shah (2012) is another writer who makes the same point: that it is important for the education objectives to make newly implemented curriculum reforms, including those to the science curriculum, relate to the society and culture of the teachers, teachers' educators, parents and students. Moreover, the material being learnt is intended to respond to the new world and the new technologies as they appear, to economic developments and the international political situation; it must also demonstrate that it will maintain the status quo in the nation and respect its historical and cultural identity.

Idris et al. (2012) argue that a national identity develops by the innovation of new curricula, which emerge as a result of the destruction and reconstruction of social relations and structures. A new curriculum aims to improve the quality of education for students and should contain appropriate knowledge; all reformers must bear in mind that the knowledge transmitted to the students composes part of their identity.

The curriculum reform process is directed to fostering the social cohesion between individuals, according to Mao (2008) and Grossman et al., (2007); those who are responsible for preparing the curriculum use the language of the nation but want to include other, more exotic notions and ideologies which may upgrade citizens' minds to promote the country's political, economic and cultural development to a level where a new generation will positively accept a pluralistic identity. Shah (2012), Idris et al., (2012) and Mao (2008) believe that the most appropriate way of implementing a curriculum is to adapt it to the students' normal life. Seiler (2001) also comes to the same conclusion, claiming that imposing the standards of a mainstream science curriculum on inner-city African-American students will have little effect in bridging the gap in science achievement, because this approach does not look at the social and cultural contexts of such students.

Khan (2010) suggests that mismatches between the new norms of modern curricula and the standards, beliefs and norms of the teachers have a negative influence on and somehow disrupt cultural, religious, and traditional beliefs, while teachers fail to explain the Westernised curricula to their students. In addition, BouJaoude and Gholam (2013) consider that socio-cultural norms and the students' everyday assumptions can have a negative or positive influence on students' achievement and their attitude to science. So, they assert the need to take into account the socio-cultural context of the students in reforming the science curriculum.

From the previous argument the importance is clear of to relating the science curriculum in the students' needs, social-culture and daily life, so the question which emerges here is, does the science curriculum have to focus on the local culture only? This point is argued in some studies.

Aikenhead (2008), in his study about importing the science curricula from Euro-American countries into Asian countries, suggested that it is important to balance these two different cultures in the science curriculum, which means in other words to make a balance between the content of the imported Euro-American science programmes and promoting culturally sensitive school science to meet local needs, while paying attention to political issues that may limit these topics. In another study, Aikenhead (2001) discussed cross-cultural science teaching. He indicated that Aboriginal knowledge and languages are treated as an asset in the science classroom, rather than adopting a deficit model whereby an Aboriginal background would put a student at a disadvantage in school science. There are advantages that accrue to Aboriginal students who can see the world from two different perspectives (Aboriginal and Western), and who can choose the one that better fulfills their goals at any given moment. The flexibility to move back and forth between cultures is a definite asset in society today. But the role of the teacher is paramount: ‘‘most students require assistance from a teacher, similar to a tourist in a foreign land requiring the help of a tour guide. In short, a science teacher needs to play the role of a tour-guide culture broker’’ (Aikenhead, 2001. p. 340).

In addition, Reiss (2000) indicated that the curriculum reformers should think about ‘multicultural science’, within which pupils can be helped to see that science is a cultural activity and it is inevitably the case that different cultures produce different sciences (Reiss 2000, p. 18).  In another study by Reiss (1993) he argues that science is for all and the science education should be universal and is to encourage students to wonder about the natural world and to shape their own scientific thinking.

The previous argument shows the importance of making a balance between local culture and international culture when reforming the science curriculum, and in teaching and learning the science curriculum in the classroom, because science is universal and the teacher plays a pivotal role in achieving this balance in the classroom.

In addition, some writers discuss curriculum reform and socio-cultural norms, but with a different emphasis. They examine not only the problem of relating curriculum content or objectives to the students' society and culture but add that the visual images used in learning activities and in the textbook also need to take account of the students' social culture and environment.

According to Pauwels (2006, p. 12), illustrators ''need to be well-versed in both the art of illustration and in specialised fields of science'' so that the result is both accurate and appropriate for the age and level of the learners. But there is a socio-cultural dimension of visual images; they depend upon the context in which they are seen and the people who are seeing them.

Harrison (2003) adds that if the sender and receiver of an image come from different cultures, then its original meaning may not make any sense at all. There may be moral, religious or cultural reasons why some images are inappropriate. Some animals or objects may not be recognisable to students, or may have bad connotations. This problem addresses the field of visual semiotics but few curriculum reformers consider these issues when reforming the science curriculum.

The use of Western-based images can pass on an exclusively Western view of science, suggesting to children in non-Western countries that this is a superior culture, or, in even more extreme cases, the absolute truth (Aikenhead & Jegede, 1999). Images derived from Western sources can help to support and spread these distortions and this is why textbooks should be furnished with culturally appropriate images for each context in which science is taught.

As a solution to these issues Pauwels (2006) contends that ''each visual representation should be linked with its context of production'' (p. 21). The implication for this in teaching is that the images, colours and styles of illustrations for use in the classroom should not be too distant from the local culture. Locally produced images minimise cultural misunderstanding and increase the likelihood that the intended lessons will be learned and will not be peripheral to students, having nothing to do with science and everything to do with an alien culture.

Focusing more narrowly on the socio-cultural context of curriculum reform, this current study concerns the Arab country of Kuwait so it is important to discuss the Arab countries' socio-cultural norms and how they can relate to a science curriculum.

### 3.4.3 Arabic socio-cultural norms and their reflection in education

The phrase 'the Arab countries' refers to the territory which comprises the twenty-three states distributed between Asia and Africa (the Arab League). All these states have Arabic as their common language and an Islamic majority in their population (Rugh, 2002). According to Griffin (2006), these countries may be called either Arab countries or Muslim countries because most of their population is Muslim, and in some Arab countries such as the Arab Gulf states, the whole population follows Islam (Griffin, 2006).

However this section of the present chapter calls 'the Arab states' those which adopt Arabic as the official language and whose people speak Arabic as a first language; it uses the term 'Muslim countries' to include all countries that adopt Islam as a basic state religion even when Arabic is not their first language, such as Pakistan, Indonesia, Malaysia and others. This section focuses, as part of the context of this study on the Arab states and on the unquestioned similarities in their social culture, customs and traditions, to discuss the specifications and context of Arabic-Islamic culture and to ask how far this culture impacts on the science education in these countries.

Given that these Arab states are most obviously similar in language and religion, each Arab state has its own culture, influenced by Islam, as shown in its education and upbringing of young people (Griffin, 2006). To clarify how Islamic culture is reflected in the education systems, there follows a discussion of the impact of such a culture on the education in these states.

Kirdar in one of his chapters notes how the culture essentially influences the education of women. In the past, women in some Arab states used to be unable to receive formal education and indeed, in some states, such as the Arab Gulf states, habits and social traditions based on Islam made it a disgrace for women to leave their houses for education or work. But, Kirdar goes on, this situation has since changed;

women can now study and be employed. However, the culture, social customs and traditions still influence education in these states. For instance, schools for males and females tend to be separate in the Arab Gulf states (Kirdar, 2006).

Singh (2006) also makes this point, citing as the reason that the Arab-Islamic culture does not encourage the intermixing of men and women. Singh gives other reasons for this influence, too: that Arab Muslim societies have a conservative nature and that this has an effect even on the choice of specialisation in college: most females, in particular in the Arab Gulf states, choose to study in the colleges of education during their university undergraduate study because they desire to have jobs within an environment segregated from males (Singh, 2006; see also Rephaeli, 2005 & Rugh, 2002).

Kirdar agrees, commenting that these women want to be teachers, not because they love teaching or are even interested in it but because their culture, customs, traditions and religious beliefs prefer the women's workplaces to be quite separate from those of men. The teaching profession is most targeted in this respect (Kirdar, 2006; Rephaeli, 2005; Rugh, 2002 & Singh, 2006). This may have an adverse impact on the performance of teachers, who are not always creative in function and may perform unsatisfactorily because they did not choose this profession but were directed to it by custom and tradition (Kirdar, 2006).

Despite the present improved situation, it is clear that the Islamic culture has had a significant impact on education. This indicates the importance of taking the religious culture into consideration in the reform process of the science curriculum.

This is agreed by Shaw (2006) who advises that the Arab Islamic culture must be reflected and taken into account in the education reform process in the Arab states. He says that one of the most important goals of education in most Arab states is to create citizens who can serve and develop their country. To this end, Shaw believes that the curriculum content must connect to the social-culture of the students, including the Islamic culture, and that it must illustrate how to make use of science in developing their country and in solving the problems of everyday life. He states that correlating whatever may be studied by the student to the relevant culture and society contributes significantly to attaining the educational goals (Shaw, 2006). There is a consensus that science curriculum must relate to every aspect of life and to the environment of the students. The science curriculum should be concerned with the desert environment which characterises most Arab states, their natural resources and the ways to sustain such resources. In one of Shaw's examples, the Arab Gulf states, unlike other Arab states, are characterised by dependence on oil in the national economy, which results in generally higher standards of living. By associating this fact with other studies, the students should learn how to make use of oil in their country's development; this is valuable, since whatever they learn contributes to their capacity to develop their country (Shaw, 2006).

Undoubtedly the culture of the Arab-Muslim societies has been influenced by Islam, which is reflected in the customs, traditions and everyday life of the society, including the education. Hence, the culture, environment, needs and everyday life of the society should be taken into account in educational reforms, including curriculum reform.

In light of the above discussion, it may be useful to discuss next the relationship between science and religion, first in general and then with particular reference to Islam.

### 3.5 The relationship between science and religion

The relationship between science and religion is often debated; this section explores this relationship, its advantages, disadvantages and the context. Nord and Haynes (1998) found a set of positions on the relationship between science and religion. There are four possibilities: first conflict, where religion outweighs science and provides the only reliable knowledge; second, conflict where science outweighs religion and provides the only reliable knowledge; third, independence of one from the other, each having a distinct domain, so that neither theologians nor scientists need to consider each other's conclusions; and fourth, integration, where religion and science make commensurate effort; they may conflict but they may also support each other. Instead of ignoring each other, they provide complementary methods of seeking the truth. These models resemble Barbour's models (1990). There are also other possible relationships, for instance through dialogue.

Alexander's (2007) possible models of the relationship between science and religion are conflict, Non-Overlapping Magisteria (NOMA), fusion, and compatibility (also known as 'complementarity'); he concludes that the complementarity model is the most fruitful for the task, or at least the one offering most benefit. This is supported by Dagher & Boujaoude (2011) and by Guessoum (2008), who all point to a general tendency to promote compatibility between religious views and science.

Moreover, Reiss (2008) describes the relationship between religion and science as mutuality, benefiting both partners. When the relationship is of independence it can take three shapes: first, showing the scope of religious knowledge to be much smaller than that of scientific knowledge with no overlap between them; second, showing that the scope of religious knowledge is much smaller than that of scientific knowledge and mostly contained within it; and third, found where the worldview is mostly religious, showing that the scope of religious knowledge is much bigger than that of scientific knowledge and contains it all. Thus, the variations in understanding this relationship are due to the considerable variation in the ways of visualizing both religion and science.

Mahner and Bunge (1996), however, challenge the popular view that religion and science are compatible or complementary. They see science and religion as not only different but also incompatible. In addition, religious education seems to them an obstacle to developing a scientific mentality, in particular in early education. As a result, they suggest keeping religious education distant from state schools and universities, and teaching children what science knows about religion in terms of history, biology, psychology and sociology.

In the interests of compromise Sharpe (2002) proposes that science and religion have an integrated relationship, each accepting knowledge of the other. Moreover, he claims that religion and science can together build a prosperous world of energetic, life-directing, inquiring and truthful knowledge. Reiss, in a later work (2013) examines two situations in which matters of religion can be included within science teaching; when teaching about evolution and when teaching about the nature of science. To include religion in these subjects is useful for helping students to realise why certain things come within the field of science and others do not.

Since this is a key notion, science educators and curriculum reformers should consider the relationship between religion and science and the influence of this on science education. This is one of many reasons justifying such a consideration, including the one that a religious perspective could hinder the learning of science for some students. For others, a religious perspective on life shapes how and what is learnt in science and in other areas of knowledge. Hence, the presence of aspects of religion in science lessons could help such students to find these lessons interesting and intellectually challenging. Moreover, it enables students to realise what the scientific worldview is with regard to origins, but not necessarily to accept it (Reiss, 2008). In the later study of the same author Reiss (2010) illustrates how a connection between science and religion can help students learn science better:

> *Teaching about aspects of religion in science classes could potentially help students better understand the strengths and limitations of the ways in which science is undertaken, the nature of truth claims in science and the importance of social contexts for science. In that sense, considering religion within science education places the issue squarely within the consideration of mainstream socio-scientific issues. (p 97).*

According to Hanley (2012) the religious-cultural environment is assumed to have an impact on scientific work, showing the importance of the relationship between contemporary science and religion and justifying the need to know more about both. Billingsley (2013) finds that social constraints are felt in science classrooms and are effective in hiding students' perceptions of the relationship between religion and science as their teachers see it. Hence, it is important for students to become aware that religious perspectives are not necessarily scientifically indefensible. However, Reiss (2010), called for taking the relationship between science and religion into consideration when teaching and learning science, and he mentioned,

> *It might be thought by some to be surprising that science educators need to give serious consideration to the relationship between science and religion and the implications of this for science education. However, there are a number of reasons why such consideration is needed. For a start, and from a rather negative perspective, there is*

> *growing acknowledgement that for some students a religious perspective can hinder the sort of science learning that most science educators would like to see (p. 92).*

It can be concluded from the above that relating science to religion is important and should be taken into account in any educational process. In addition, in the above argument the literature related to scientific and religious questions provided different perspectives on the relationship between the two. However, for Islam, the situation is more complicated. The next section moves from questions of science and religion in general and considers the relationship of science and this particular religion.

### 3.5.1 Science and the Islamic religion

The Muslim religion, first of all, depends on the Qur'an, the holy book of all Muslims, from which Muslims learn the teachings of their religion and the worship of Allah/God. In addition to the Qur'an there are the sayings of the Prophet Mohammad, which Muslims call the Hadith. Islam in the Arabic world is not merely a creed but influences people's everyday lives. This is discussed by Al-Saleh, (2007), who gives examples of the influence of Islamic religious beliefs in Muslims' lives: that Muslims eat only Halal food; that women wear the Hijab (head covering); that relationships between men and women are taboo unless they are married, and so on. Many actions and circumstances are influenced by belief in Islam. Shaw (2006), for instance, mentions that the Arab states, in particular the Arab Gulf states, largely adhere to the Islamic culture, which is reflected in many details of their everyday life (Shaw, 2006).

Dagher and BouJaoude (2011) add:

> *For the most part, religious affiliation not only affects the home culture and outlook on life, but combined with financial means it can affect the type of school and education that parents choose for their children and/or their future ability to gain employment or even engage in political leadership. It is commonly recognised by all that education provides vital means for social mobility and for improving financial status. (p. 82)*

Regarding science and the Islam religion, Mansour (2011) finds that the two are compatible and any conflicts between them are only due to a misunderstanding of the nature of science and the Islamic stance towards it. Mansour emphasises that the nature of science is part of a Muslim's life and Islam does not contradict science, nor vice versa. He goes on to say that a science curriculum containing Quranic verses which explain natural phenomena could also strengthen a student's faith in Islam. In other words, no scientific phenomenon that has been described in the Qur'an or Hadith should be excluded, but, on the contrary, should be taken into account. Therefore, science teachers should give examples from the Qur'an and Hadith in science lessons (Mansour, 2011).

For instance, as Robottom and Norhaidah (2005) maintain in their study of Western science among Islamic learners, the Qur'an calls Muslims to observe and study nature as a means of bringing them closer to God; in other words, Islam considers the notion of monotheism (Tawhid), to be connected to science and the study of nature, as it is to all fields of knowledge. Islam also advocates scientific investigation into the nature of the universe, in order to explore God's creation. At the same time the Qur'an and Hadith encourage Muslims and even adjure them to track the truth to all possible sources. Therefore, from the Islamic perspective, religion needs science so long as its explanations are credible and based on evidence; equally, science needs religion to integrate its knowledge and form a feasible world (Robottom and Norhaidah, 2005).

In addition, Guessoum (2008) emphasises that the influence of the Qur'an on the Muslim mind and shows that scientific knowledge is to be found among the tools for interpreting Quranic verses. Moreover, showing that a scientific theory is consistent with what the Qur'an says could be used to persuade Muslims of its truth.

Salleh et al. (2011) contend that there are many verses of the Qur'an which clarify and prove scientific facts in many fields, such as the medical, biological, physical and cosmic. The Qur'an mentions many scientific arguments and many scientific phenomena which require deep thinking and hard work to explain them, such as: cell proliferation, rain and clouds, earthquakes, volcanoes, the sun, moon and stars, and many others. If the appropriate verses of the Qur'an were included in science lessons, they could make certain natural phenomena more accessible and help students to learn science better. The Qur'an also says that God rewards students who are looking for truth and differentiates between scientists and other people. Thus, the Qur'an mentions that God respects the scientists more than other people because they have more knowledge of the nature of science and thus may have a stronger faith in God than others and this can encourage the people to learn and search (Salleh et al, 2011).

Many researchers find no conflict between Islam and science and, further, claim that Islam encourages research and exploration. They confirm the importance of connecting the science curriculum to the culture of Muslim societies, because this makes the science more accessible to the students (Loo, 2001; Mansour, 2008b; Shaw 2006). The advantage of doing so, as identified by McGinn (1991) in his study of science, technology and society, is that the science curriculum when related to the students' Islamic beliefs will contribute positively to their attitude to science because it makes them sure that this curriculum is related to their everyday lives (McGinn, 1991).

This point is discussed by Loo (2001) in his study of Islam and science; he claims that Islam is relevant to science and cannot be separated from it, least of all in the curricula offered to Arab learners. Loo also indicates that scientific ideas which are studied in schools are included in the Holy Qur'an, such as those concerning the universe, the human body, the growth of organisms and so on.

Mansour (2010) considers the views of science teachers in this regard, reminding us that the Holy Qur'an in many verses articulates scientific ideas which were demonstrated later in scientific studies. He maintains that the Holy Qur'an encourages scientific research to reach the truth from every source and suggests that it is necessary for the science curriculum to be relevant to the Islamic Arab culture of students in the Arab states.

The same writer (Mansour, 2008a) emphasises the relationship of science education to Islam and its impact on the educational role of the teacher in his study of the views of science teachers in Egypt. The results of the study show that the religious beliefs of the individual are one of the most important factors impacting on science teachers in their performance within the classroom and that teachers, in their role in education, are influenced by their individual Islamic religious beliefs. Mansour reported that science teachers in Egypt believe that the science curriculum is limited and unable to respond to today's scientific challenges on its own; it needs the support of religion, since for Arab-Muslim students some scientific explanations may be stated more realistically and credibly in the verses of the Qur'an (Mansour, 2008a).

In addition, Loo (2001) asserts that Arab Islamic scientists in the past, specifically in the twelfth century, were the leading inventors and explorers of their time. Among these scientists were Ibn Sina, Al-Farabi, Al-Razi and others, whose history should be known by Arab Muslim students, since their example encourages more research and exploration (Loo, 2001). This is supported by the argument of Faruqi (2006) that Muslim scientists have played a major part in many branches of science, such as mathematics, optics, medicine, biology and others. Hence, mentioning them and their achievements in the science curriculum will enhance the motivation of Muslim students and encourage them to follow the example of these scholars, in addition to making them proud of Muslims' achievements in science (Faruqi, 2006).

Furthermore, in Christian natural theology, as in the traditions of the Islamic scientists, nature is seen to be reflecting God and studying nature is a way of knowing God much more deeply. In some Arab states, this type of thinking is still reflected in the science curriculum. For example, in Jordan, the science curriculum is designed to enable students to understand the universe better and thereby to strengthen their faith in God (Dagher, 2009).

Many of the writers mentioned above have shown that the relationship between science and Islam is complementary and that it is important to think of the two in relation to each other. The Qur'an and Hadith encourage people to research and explore ideas. Many scientific facts which are included in the Qur'an can be taught in the science curriculum.

But there are also some scientific findings which may conflict with Islam and may impact negatively on students and teachers; what should be done with them? Should we minimise the conflict in our teaching? Scientific topics which conflict with Islam are discussed in Mansour's (2011) study about science teachers' views of science and religion. In this he cites cloning as one among several controversial topics which contradict the principles of Islam, but on the other hand the Islamic religion encourages people to search, learn and get knowledge from any resource. Mansour concluded that science curriculum may include such topics when the science curriculum is reformed with observance to the Islamic culture (Mansour 2011).

Another topic which may conflict with the Islamic religion is the theory of evolution , and this theory and how it can be taught in the Islamic world are discussed by Mansour (2010), who judges it worth mentioning that most scientific theories were developed by Western scientists whose beliefs conflicted with Islam. This is of the gravest concern to Islamic science educators. For instance, the theory of evolution claims that all the organic beings that have ever lived on Earth have evolved from earlier forms of life, which opposes what is said in the Qur'an, so to resolve this issue Mansour suggested to teach this conflicting theory and argue it with the Islamic religious beliefs, and this needs a professional development programme for science teachers. Furthermore, Mansour discussed when developing programmes for teaching scientific topics which have a religious dimension that it is important to consider the continuous interaction of the students' and teachers' cultural and social contexts with their personal religious beliefs. It is also important to review and examine such beliefs periodically and regularly, given that new issues for debate will continually appear as a result of technological developments and the emergence of new scientific discoveries, which should be dealt with deliberately and educationally (Mansour, 2010).

Robottom and Norhaidah (2005) discuss a similar idea, adding that we should not lose sight of the fact that many theories and facts are put forward by non-Muslim scientists who in any case may have different beliefs from Muslims. Therefore, teaching Western science in a way that ignores Islamic scientific culture could impact negatively on the students' sense of identity and their attitudes to science or to future working in a scientific field; a science curriculum needs to be carefully adapted to suit many students' religion and culture (Robottom & Norhaidah, 2005).

In addition, there are some views, theories, facts and truths which should be taught to all students regardless of whether or not they conflict with religion, but which encourage discussion of students' religious beliefs. Reiss (2010) writes about such challenges, acknowledging that some students do not accept certain items of scientific knowledge or scientific theory at all, such as the theory of evolution, because it conflicts with their religious beliefs. He emphasises that these views should be respected, but suggests that the theory should be taught to all students so that they can understand, but not necessarily accept, the scientific worldview with respect to human origins. He mentioned,

> *I do believe in taking seriously and respectfully the concerns of students who do not accept the theory of evolution while still introducing them to it. While it is unlikely that this will help students who have a conflict between science and their religious beliefs to resolve the conflict, good science teaching can help students to manage it - and to learn more science. (p. 100)*

He added that teachers should be cautious before teaching this theory in science classes and that the curriculum needs to be suitable and the teachers need to be trained, the latter by receiving continued professional development to take care of such problems. This will help the students ‘‘to appreciate the way science is done, the procedures by which scientific knowledge accumulates, the limitations of science and the ways in which scientific knowledge differs from other forms of knowledge’’ (Reiss, 2010, p.100).

El-Baz (2009) agrees with this point, asserting that Arab countries should welcome and absorb knowledge regardless of where it originates, even if it comes from different religions, races and nations. He adds that knowledge which may conflict with Islamic belief may still be taught in Arab countries and discussed in the light of Islamic belief and truth, because this will encourage students to seek the truth, affect positively their attitude to learning and develop their investigating and thinking skills.

Al-Demerdash (2013) discusses a scientific advance, cloning, which conflicts with Islamic precepts because it depends on the artificial production of new cells. He suggests that this issue shows how, despite the fact that it conflicts with Islamic beliefs, the science can be exploited. He argues that the cloning has happened and that Muslim people should not ignore this, but can accept the benefits from it; it is possible to take advantage of this technique and develop it for use in treating many diseases which are incurable at present, such as certain forms of cancers (by eliminating the cancerous cells and helping the body to produce new intact cells). Such issues that conflict with Islamic beliefs nevertheless need to be taught to students and the issues examined carefully, in the light of belief, and the students encouraged to discover the truth for themselves.

From these arguments it is clear that when teaching scientific theories and knowledge in Arab and Islamic countries they may be discussed in light of Islamic religious beliefs because this will contribute to and encourage seeking the truth and developing the skills of investigation and critical thought.

Islam, rather than conflicting with science, encourages research and exploration; any reform process to the curriculum should connect the science curriculum with Islamic religious culture and beliefs and in Islamic states may lawfully do so. There are many scientific ideas expressed in the Holy Qur'an and confirmed by scientific studies. Thus, it should be of primary concern to connect the Arab Islamic culture to the material of the science curricula studied in schools. The question remains whether the science curricula in the Arab states in general, and in Kuwait in particular, actually does so.

### 3.6 Gaps in the knowledge revealed by the literature review and the research questions

Many educational research studies in science curriculum reform in general and the relationship between the science and social-culture and religion in particular were reviewed. The reviewed literature informed the study by emphasising the views of teachers and students on the reform and development of the science curriculum, and that involving them is necessary to the success of any curriculum reform process. In Kuwait which is this study's context, the teachers' and students' views were absent because the science curriculum was reformed by the policy-makers in the MoE with a lack of consultation with teachers and students and this may have negatively influenced teacher and student attitude toward the new science curriculum. To fill this gap, in the current study the teachers and students are main participants, with their views explored about the new science curriculum and the reform process. This will help to create a comprehensive framework to further the science curriculum reform in Kuwait which could be informed by this study finding.

In addition, the above arguments from the literature review showed the importance of the social-culture and religion in teaching and learning science and the necessity of these factors being taken into consideration when reforming the science curriculum. The reviewed of literature also showed that the culture and religion of the students and teachers impact on the teaching and learning of science and on students' understanding and attitude toward science, and also on teachers' teaching performance. This is argued by the social-culture theory (SCT) which was used as the theoretical framework in this study, which indicated that social interaction, culture and daily life play a major role in the process of teaching, learning and cognitive development (Vygotsky, 1987).

Regarding this point, the new science curriculum in Kuwait was imported from the USA which has a different social culture and religion, and it was adapted by the policy-makers to be suitable for Kuwaiti students, however introducing a science curriculum without careful adaptation to the context in which it is being taught may well lead to difficulties for both teachers and students. To fill this gap, in this study the reform process including the adaptation process were explored in depth from the points of view of policy makers, teachers and students to understand to what extent the new science curriculum is compatible with Kuwaiti culture, needs, daily life and religion, and to what extent these are influenced in teaching and learning science.

The reviewed literature suggested SCT as the appropriate theoretical framework to understanding and discussion of the participants' responses and to explaining the teachers' and students' views about teaching and learning the science curriculum. In addition, the reviewed literature provided the appropriate methodology, methods of data collection and helped in formulating the research questions by looking for gaps in the reviewed literature.

Based on the previous literature, my personal experience and discussion with my supervisors, the main questions of the research are:

1. What were the factors that guided and influenced the science curriculum reform process in grades six and seven of the intermediate stage?
2. What were the phases of the science curriculum reform process in these grades?

3. What are the teachers’ views on the new science curriculum in these grades?
4. What are the students’ views on this new science curriculum in these grades?

### 3.7 Summary of the chapter

This review of the literature relating to the definitions, importance and components of the curriculum; science curriculum reform; the teachers’ and students’ roles in it; Kuwait’s curriculum reform and its socio-cultural context, has illustrated the importance of curriculum reform and that a science curriculum should be relevant to the society’s culture, needs, everyday life and religion. In addition, the arguments indicate that the more the science curriculum is linked to the students’ culture and everyday life, the more this contributes to students’ understanding of the content of science lessons, and has a positive effect on students’ attitudes to science. The literature also indicates that it is important to engage teachers and students in the process of reform and development of the curriculum and listen to their views.

It is also clear that when it comes to reforming the science curriculum in countries where religion plays an important part in everyday life the relationship between science and religion should be considered. Much of the literature discussed in this chapter indicates that the relationship between science and religion is complementary and that scientific theories and discoveries can be taught to all students whether or not they conflict with religious beliefs. Previous writers argue that teachers need more professional training courses about relating science and religion in science lessons. Islam does not conflict with science; on the contrary, the literature confirms the need to link the science curriculum in Islamic countries to the religious culture, for this makes the scientific content more accessible.

# Chapter 4

# Research Design and Methodology

## 4.1 Introduction

A research design guides the researcher towards answering research questions by choosing suitable methods of collecting and analysing data, before discussing the findings to form a conclusion. According to Kumar (2005), the research design is a complete scheme or programme for the research, which involves identifying a problem to research and continuing by analysing the results

This chapter focuses on the research design of the study. The following aspects are described in detail: the research paradigm, ontological assumptions, epistemological assumptions, methodology, population and sampling strategy, methods of data collection and the procedures of data collection, data analysis and validity. Ethical issues are also discussed.

## 4.2. Research Paradigm

A research paradigm is a wide framework of discernment, perception and belief within which theories and practices function. The research paradigm refers to the set of rational ideas about the functioning of the world, rules by which researchers work and the mental imageries that determine their research actions (Johnson & Christensen, 2012). Gephart (1999) argues that a research paradigm can be placed in one of three philosophical perspectives: interpretive, positivist and critical theory (Gephart, 1999).

This study used an interpretive philosophical paradigm. MacNaughton et al. (2001) indicate that interpretivism seeks to explain how people make sense of their circumstances, that is, of ‘the social world’. According to Orlikowski and Broudi (1991), ‘‘The aim of interpretive research is to understand how members of [a] social group, through their participation in social processes, enact their particular realities and endow them with meaning and to show how these meanings, beliefs and intentions of the members help to constitute their social action.’’ (p. 13)

To explore these issues within the interpretive paradigm in this study, both quantitative and qualitative data are used, through interviews, questionnaires and classroom observations, to interpret the process of the reform of the science curriculum in Kuwait and the views of science teachers, students and science curriculum reformers on the new science curriculum and the curriculum reform process. In addition, this study focuses on investigating how relevant the teachers and students thought that the new science curriculum was to the society, culture, needs, daily lives and Islamic religion of their country. It also investigates the support and relationship between the MoE, science teachers and students in relation to these curriculum reforms.

**4.3 Ontological Assumptions**

Ontology is the science of a philosophical discipline, and considered as a kind of philosophy that addresses the nature and combination of reality, where it focuses on the nature and combination of things, apart from any other considerations, and even in isolation from their actual presence (Guarino et al, 2009). Crotty (2003) defines ontology as ‘‘the study of being. It is concerned with what is, with the nature of existence, with the structure of reality as such.’’ (p.10)

This definition can be clarified and simplified by turning to Blaikie’s definition, which suggests that ontology is a set of ‘‘claims and assumptions that are made about the nature of social reality… claims about what exists, what it looks like, what units make it up and how these units interact with each other… In short, ontological assumptions are concerned with what we believe constitutes social reality.’’ (2000. p.8).

The ontology of this research is ‘multi-realism’ because it involves socially constructing the reality of how the reform of the science curriculum is seen by students, teachers, and reformers. Each of them forms a source of reality that gives multiple perspectives of all participants. Therefore, a focus upon people's ‘perceptions of reality’ is needed where one set of perceptions is as good as another. So, the reality here needs to be explored and constructed from the multiple perspectives of students, teachers, and reformers, by bearing in mind that although the teachers might have similar experiences and work under similar conditions, this does not mean that their knowledge is the same, and thus constitute one reality. This is because their interpretive frameworks through which they filter these experiences and conditions are different. Therefore, in studying teachers' knowledge, it is necessary to access teachers’ reasoning of their views and practices; the same for students and reformers.

Moreover, in this research subjective reality was investigated through the questionnaires, interviews and observations with students, teachers and reformers. Ontology assumes that meaning is embedded in participants' experience and that it is grounded in social interaction. This is closely related to the interpretive paradigm adopted in this study which sees the world as constructed by human actors in a social environment (Leininger, 1985).

In this study the elements of ontology are explained, from the data collection to a classification of what will be understood from questionnaires, interviews and classrooms observations where participants' beliefs will include some social evaluation. My evolving notions of reality will shape both data collection and analysis. When the study began, the questionnaire data, interview transcripts, and observation notes were viewed as the only source of data; what could be viewed as real data was confined to the recorded words of the participants. Field notes of classroom observations and interview reflections are considered as additional data sources. All data remain reconstructions and as Charmaz (2000) stated, ‘‘Thus the research products do not constitute the reality of the respondents' reality. Rather, each is a rendering, one interpretation among multiple interpretations, of a shared or individual reality’’ (p. 523).

### 4.4 Epistemological Assumptions

Wellington (2000) defines epistemology as ‘‘the study and validity of human knowledge’’ (p.196). ‘‘Epistemology deals with the nature, sources and processes of knowledge/knowing’’ (Baptiste, 2001. p.5). In social sciences, the individual meanings and actions should be taken into consideration. In addition to the culture and history interpretations, the values of social actors, structures and patterns need to be considered (Soini et al., 2011). Furthermore, epistemology concerns how people know what they know, what they mean when they says that they know something, and the view of how one acquires knowledge, including the assumptions about the nature of knowledge (Mack, 2010).

The epistemologies for qualitative research seek to illustrate and highlight the variety of the personal stances and epistemologies. Researchers adopting a qualitative perspective are interested in understanding the participants' perceptions of the world. However, the adopted approach and the selected methods of data collection both depend on the type of information needed and the nature of the inquiry (Becker, 1996).

The epistemology of this research is constructionism. In constructionism Crotty (2003) argues that 'meaning is not discovered, but constructed'. In this understanding of knowledge, it is clear that different people may construct meaning in different ways (p.9). In other words, everyone has his/her own view on what they perceive reality to be. The aim is to construct an understanding of how students, teachers, and decision-makers see the reform of the new curriculum. Crotty (2003) also argues that: ''In this view of things, subject and object emerge as partners in the generation of meaning'' (p.9).

The research also adopted a mixed-methodology approach and an epistemological mix by combining qualitative and quantitative research as complementary strategies appropriate to different types of research questions. In the current study, a quantitative survey was suitable to know the range of agreement or disagreement with the views related to the knowledge of the teachers and students, whereas qualitative methods such as the interviews and classroom observation were used to understand the nature of these views, their relationship to practice and how this relationship was influenced by the context in which the teachers work.

However, the closed questions that were included in the questionnaires are considered as structured questions, which differ from the open-ended questions that were included in the interviews. Questionnaires can be superficial and less explicit whereas interviews give the participant the freedom and the required time to express their views (Soini et al., 2011). Epistemology deals with what constitutes valid knowledge and how it could be obtained. So, in this study, the sources of knowledge are students' and teachers' perspectives about the new science curriculum, gained through questionnaires, interviews and observations. Interviews were conducted with reformers who reformed the science curriculum, to understand how the reform process was carried out. To achieve a defensible perspective the research included the participants' perceptions, beliefs and intentions. When analysing the data, the research takes into consideration the differences in the nature of knowledge and experiences among students, teachers, and reformers.

### 4.5 Research Methodology

Methodology is the ‘‘analysis of the assumptions, principles and procedures in a particular approach to inquiry’’ (Schwandt‘ 2001, p. 161). It is seen as ‘‘theory [about the] methods and techniques… appropriate to generate and justify knowledge’’ (Ernest, 1994, p. 4). Both quantitative and qualitative methodologies are used in this research to obtain data from multiple sources.

Using the quantitative and qualitative methodologies is valuable, Creswell (2012) argues:

> *If you have access to both quantitative and qualitative data, you can use both forms of data to understand your research problem and answer your research question. With qualitative research now accepted by educational researchers and with quantitative research long established as an approach, mixed methods research has become popular as the newest development in research methods and in approaches to ‘mixing’ quantitative and qualitative research. (p.534)*

Quantitative and qualitative research can complement one another, the former playing the part of an explorer and the latter confirming its discoveries (Gall et al., 2006). Furthermore, Creswell (2012) explains that the research problem, the questions and the literature review orient the researcher toward either quantitative or qualitative methods, where they determine the design to be used and the procedures involved in it, such as sampling, data collection equipment or protocols, the procedures, the data analysis and the final interpretation of results. Creswell also finds that mixed methods best accommodate and illustrate the research problem, treating data from a variety of information sources. They are also more useful in addressing educational problems, where they can yield profound, detailed data through being combined (Creswell, 2012).

Yin (2006) agrees with Creswell that using mixed methods strengthens and broadens a study, but points out that the dilemma is how to keep the study coherent. Mixed methods can benefit research by increasing the compatibility of the questions and conducting analysis in an appropriate beneficial way.

Another important aim of using mixed methods is to give a study value by strengthening its findings. Johnson and Onwuegbuzie (2004) argue that validity is achieved in mixed methods approaches through combining the integral strengths and non-overlapping weaknesses of quantitative and qualitative research. They note that assessing the validity of findings is hard, calling it a problem of integration, as Yin also does. Johnson and Onwuegbuzie (2004) define mixed methods as a synthesis of quantitative and qualitative methods in one investigation, to reduce the shortcomings inherent in one method and adding to the strength of the other. Tashakkori and Teddlie (2003) also note that the use of mixed methods is an effective way of validating the information gathered from a single approach.

After considering the previous arguments, it was decided that this study would collect data from a wide range of sources and thus needed a mixed methods design, incorporating both quantitative and qualitative methods.

### 4.6 Methods of data collection

The choice of methods of data collection depends upon such factors as the study's purpose, research questions, resources available, the time available, sample size, costs and researcher's experience (Kumar, 2005). If there are varied sources of information, it is better to have many methods for collecting data (Johnson & Turner, 2003) in order to exploit the advantages of each in answering questions. In this study three types of data collection methods (interview, questionnaire and observation) were used to answer the research questions and achieve the study aims (Table 4.1). Multiple data collection methods, such as interviews, questionnaire and observation, are complementary and form a more complete and coherent picture of events than would be provided by any single method (Yin, 2003).

**Table 4.1:** An outline of the relationship between research questions and methods of data collection.

| | Research Questions | Methods |
|---|---|---|
| 1. | What were the factors that guided and influenced the science curriculum reform process in grades six and seven of the intermediate stage? | Reformer interview |
| 2. | What were the phases of the science curriculum reform process in these grades? | Reformer interview |
| 3. | What are the science teachers' views on the new science curriculum in these grades? | Teacher interview & questionnaire |
| 4. | What are the students' views on the new science curriculum in these grades? | Student interview & questionnaire |

The different methods used to collect data from participants are discussed in turn below to show their content, aims and design.

### 4.6.1 Questionnaire

The questionnaire in this study was designed to collect the data needed to address the research aims and answer the research questions as indicated above, and was intended to obtain quantitative and qualitative data from the participants' perspectives and highlight the issues which are then investigated in more depth in the interviews. In addition, the Social Culture Theory (SCT) which is the theoretical framework of this study (see section 3.4.1, above) was taken into consideration when designing the questionnaires, in which there are some items that were designed regarding the SCT basis. The purpose of these items which relate to SCT are to provide detailed information about the current science curriculum regarding the social-cultural context, for example, those items which aimed to explore to what extent the current science curriculum relates to the students' socio-cultural needs, their environment and daily life, and the process of teaching and learning the science curriculum with regard to SCT principles. This was helpful in understanding and discussing the participants' responses.

Denscombe (2010) maintains that questionnaires should be designed to collect appropriate data that can then be analysed effectively, and should be composed of a list of questions to put to a group of identified people. It should preserve the consistency and accuracy of its results, collect data by asking questions directly on the research topics, and focus on the direct transference of data from a target group.

In this study two versions of a questionnaire, one for science teachers and one for their students, were constructed after carefully considering the advantages and disadvantages of questionnaires. Rea and Parker (2005, p. 30) find that ‘‘most questionnaires have inherent advantages as well as inherent flaws’’. Questionnaires allow direct and specific questions to be asked about the research object and they keep the answers relevant to the study subject. They are considered the simplest and quickest way to get information. The researcher can simultaneously distribute the questionnaires to as many relevant people as possible (Denscombe, 2010). Bell (2010), to give another example, asserts that a questionnaire is a good, fast and non-costly method of collecting certain types of information provided that the research sample is educated enough. McMillan and Schumacher (2010) add to the advantages of the questionnaire by stating that it contains the same questions for all the people of the sample and these questions can be written so that they do not generally reveal the identity of the respondents.

In this research, the aims and the problem were determined and then the questionnaire and its questions were designed accordingly. Many steps were kept in mind when designing the questionnaire. Gall et al. (2006) say that the first step in designing a questionnaire is to determine the research problem and specify the aim of the questionnaire in it. Slavin (1991) finds the questionnaire to be a suitable method for collecting all the information related to a situation, but it requires the questions to be modified for certain groups. For example, a long questionnaire does not necessarily collect more information than a short one. He adds that the questions should not be biased but should fully focus on the matter of the research.

In contrast, the disadvantages of questionnaires have been listed by many researchers. Gillham (2000) says that that a questionnaire will have a low response rate unless the respondents think that it is interesting and worthy of completion. It should have questions which are at the same time limited and simple, since misunderstandings cannot be corrected if the respondents have difficulty with reading and writing.

In this study, the teachers' and students' questionnaires were designed after carefully considering the advantages and disadvantages of a questionnaire to be completed by the participants, if necessary, in the researcher's absence. The questionnaires were designed attractively, using clear and simple language, and efforts were made to make them as brief as possible. The questionnaires told the respondents how to answer the questions.

As noted above, two questionnaires were used in this study, which will be described in turn. First, the science teachers' questionnaire had eleven dimensions. The first dimension consisted of demographic information, such as the grade(s) being taught, gender, specialisation, position and years of experience. The demographic information was useful when comparing different groups of participants. Table (4.2) shows the eleven dimensions.

**Table 4.2:** The dimensions of the teacher questionnaire relating to research questions.

| | **Dimension** | **no. of items** | **Research question** |
|---|---|---|---|
| 1. | The participants' demographic data | 5 | ---- |
| 2. | The teachers' views of the content of the new science curriculum | 6 | RQ3 |
| 3. | The teachers' views of the objective of the new science curriculum | 5 | RQ3 |
| 4. | The teachers' views of the assessment system of the new science curriculum | 2 | RQ3 |
| 5. | The teachers' objectives in teaching the new science curriculum | 3 | RQ3 |
| 6. | The teachers' views of the Ministry of Education's support for the teachers in the education process | 5 | RQ,3 |
| 7. | The teachers' views about the reform process of the science curriculum | 4 | RQ2&3 |
| 8. | The teachers' views of the school's support for the work of the science teachers in the school | 5 | RQ3 |
| 9. | The teachers' views of the instructional tools which are used in teaching science | 4 | RQ3 |
| 10. | The teachers' views of the teaching methods which are used to in science classes | 4 | RQ3 |
| 11. | The challenges facing the teacher in teaching the new science curriculum | 7 | RQ3 |

In the students' questionnaire, the dimensions included their view of the science subjects, their aims in learning science, their opinion of the teaching tools and of the teaching methods. The students' questionnaire had seven dimensions (Table 4.3). (For the full text of the teachers' and students' questionnaires, see Appendices 1 & 2).

**Table 4.3:** The dimensions of the student questionnaire relating to research questions

| | Dimension | No. of items | Research question |
|---|---|---|---|
| 1. | The participants' demographic details | 2 | --- |
| 2. | The students' attitude to science | 7 | RQ4 |
| 3. | The students' view of the science lessons | 9 | RQ4 |
| 4. | The students' view of the objectives in and reasons for learning science | 4 | RQ4 |
| 5. | The students view of the learning activities which are used and preferred in learning science | 4 | RQ4 |
| 6. | The students' view of the instructional tools which are used in teaching science in the classroom and lab | 5 | RQ4 |
| 7. | The students' view of the new system of student assessment | 7 | RQ4 |

According to Cohen et al. (2011), many forms of question can be used. Regarding the type of questionnaire used in this study, Kumar (2005) lists three types of questionnaire: fixed or closed, open-ended, or mixed. The first type often has questions and answers with ranked choices, the second is open-ended and consists of questions to which the respondents are free to give their own answers, and the third contains both closed-ended and open-ended types. Peterson (2000) asserts, 'The primary benefit of an open-ended question is that its answers can provide extremely insightful information. Because study participants provide answers in their own words, no researcher bias is introduced by presenting or predetermining answers.' (p. 33).

In this study both closed- and open-ended questions were used for both questionnaires. The former used a Likert scale and the questions were designed to include statements with which the respondents could agree or disagree, strongly or not, on a scale from one to four. The open-ended questions were used to give space for the participating teachers and students to present their views in more detail.

#### 4.6.1.1 Questionnaire validity

According to Balnaves and Caputi (2001), testing the validity means assessing whether the procedures used in the research to collect and analyse the received data were either bad or good. Creswell (2012) mentions that validity is tested by determining if the findings are accurate from the standpoint of the researcher. Validity in quantitative research, when it measures things of important interest, looks at the extent to which the chosen measures do what they were chosen for. Statistical conclusion validity pertains to the relationships being tested, referring to inferences about whether it is reasonable to presume co-variation, given a specified alpha level and the obtained variances (Johnson and Onwuegbuzie, 2004). Wallen and Fraenkel (2001) assert,

> *Content-related validity refers to the nature of the content included within the instrument and the specifications the researcher used to formulate the content. How appropriate is the content? How comprehensive? Does it logically get at the intended variable? Such evidence most often relies on the judgments of people who are presumed to be knowledgeable about the variable being observed. It is sometimes referred to as 'logical' or 'face' validity. (p. 89)*

The validity and accuracy of the translation of the questionnaires, particularly since both sets of questionnaires had to be translated from English into Arabic, was assessed by specialists in linguistics and translation. Subsequently, the face validity method was used to check the validity of these questionnaires. Copies of both questionnaires were distributed to five experts specialising in science curriculum reform and development from Kuwait University and the College of Basic Education. Their comments were incorporated into the development of these tools by reformulating some questions, adding new ones and changing the wording of others until they were easier to understand.  This reformulating of the questions took place once before the pilot and once more before the main studies.

#### 4.6.1.2 Questionnaire reliability

Creswell defines reliability testing generally as an examination of the stability or consistency of responses, to increase the consistency and reliability of the research, document all procedures and set up detailed procedures (Creswell, 2012). Bell (2010, p.119) defines reliability as ‘‘the extent to which a test or procedure produces similar results under constant conditions on all occasions’’. Cohen et al. (2011) find three types of reliability: equivalence, stability and internal consistency**.** In this study, the internal consistency of the questionnaire – its reliability – was tested by calculating Cronbach’s Alpha correlation coefficient. In the main study and from Table (4.4), it can be seen that the coefficient reliability of the dimensions of the teachers’ questionnaire ranged from (.729) to (.962), and of the students’ questionnaire ranged from (.738) to (.947) (Table 4.5). The alpha coefficient, as explained by Cohen et al. (2011) indicates reliability as follows: (>0.90) very highly reliable; (0.80-0.90) highly reliable; (0.70-0.79) reliable; (0.60-0.69) minimally reliable and (<0.60) unacceptably low in reliability. From these guidelines of the alpha coefficient it was clear that the reliability of the both questionnaires of the main study was high.

**Table 4.4**: The reliability of the teachers’ questionnaire

| **Dimension** | **Cronbach Alpha** |
|---|---|
| • The teachers’ views of the new science curriculum content | .775 |
| • The teachers’ views of the new science curriculum objective | .904 |
| • The teachers’ views of the assessment system of the new science curriculum | .828 |
| • The teachers’ objectives in teaching the new science curriculum | .729 |
| • The teachers’ views of the MoE support for the teachers in the education process | .898 |
| • The teachers’ views of the school’s support of the science teachers in the school | .962 |
| • The challenges facing the teacher in teaching the new science curriculum | .889 |
| **Total** | **.855** |

**Table 4.5:** The reliability of the students' questionnaire

| Dimension | Cronbach Alpha |
|---|---|
| • The students' attitude to science | .947 |
| • The students' views about the science lessons | .738 |
| • The students' views about their objectives and reasons for learning science | .842 |
| • The students' views about the learning activities which are used and preferred in learning science | .946 |
| **Total** | **.868** |

#### 4.6.1.3 The pilot study for the questionnaire

A pilot study is a small experimental mini-version of part of the main study, with several functions, designed to examine logistics and collect data beforehand in order to improve the quality and efficiency of the complete study (Robson, 2002). Oppenheim (1992) indicates that everything about the questionnaire should be piloted. The principal aim of the pilot questionnaire is to increase the reliability, validity and practicality of the eventual findings; that is, to check the clarity of questions, eliminate ambiguities or difficulties in writing, gain feedback on the presence of leading questions, check the time taken to complete the questionnaire, gain feedback on the validity of the questionnaire items, to check the readability levels for the target audience and gain feedback on the layout, sectionalising, numbering and itemisation of the questionnaire (Cohen et al., 2011). The pilot study in this research was crucial for detecting errors, assessing the clarity of each question and identifying to what extent the questions achieved their designed target and how long the questionnaire would take to complete. The pilot study for all the collecting tools (the questionnaires, interviews and observation) was undertaken in November 2011, two months before the main study. Initially the questionnaire was translated from English to Arabic and handed to four specialists in language and translation at the University of Kuwait's English Department for review. They commented on some items which did not accurately reflect their English meaning. The items were revised accordingly, without changing the original meaning. The questionnaire was returned to these experts again for a final review, when the researcher was assured that the meaning of the questionnaire in Arabic matched that of the English one.

The questionnaires were then handed to three academics in the Faculty of Basic Education in Kuwait and two from the School of Education in the University of Kuwait for comment on whether these questions and items had met the objective for which they had been designed. These academics specialise in Curricula and Science Teaching Methods and have extensive experience in designing questionnaires. Their notes were simple and included suggestions for clarifying some questions and changing the order of some items.

Afterwards, the teachers' and students' questionnaires were piloted and applied to a random sample (18 teachers: 12 male and 6 female; and 62 students in the sixth and seventh grades, 40 male (21 from grade six and 19 from grade seven) and 22 female (12 from grade six and 10 from grade seven) in four schools. The purpose of piloting the questionnaires was to identify any difficulty for the participants and to determine the time needed to complete the questionnaire; to address any problems that might be encountered in the implementation of the questionnaire, to analyse the reliability of the questionnaire and to avoid the difficulties, problems and weaknesses of the present design in the future. After the pilot study, for example, it was decided that the third question in the student questionnaire, *Do you like the cooperative learning method?* would be incomprehensible to students; it was thus reformulated to read: *Do you like to work in groups in the classroom in science subjects?* A space was inserted after each question in the teachers' questionnaire to give the participants the chance to add comments or suggestions. On the first page or the cover page of the students' questionnaire was added the statement: 'This questionnaire has no relation to the school assessment of students'. The students often asked questions in this regard, believing that this questionnaire might relate to their grade for science. The researcher supervised all the questionnaires personally and distributed them in the same week. In addition, the findings from the piloted questionnaire were analysed to gauge its reliability by using the Cronbach Alpha test. The result from the teachers' answers was .89 and from the students' answers was .90, which suggests their high reliability. It was useful to have practical experience of analysis before the main study and to explore in advance whether this analysis presented any difficulties.

### 4.6.2 Interview

Interviews were the main method of data collection in the present study. The interview as a method of collecting data is considered one of the most important methods in educational research. Nowadays, even in everyday life, speech and dialogue are the oldest methods of giving and getting information and exchanging ideas. Janesick (1998) defines an interview as ‘‘a meeting of two persons to exchange information and ideas through questions and responses, resulting in communication and joint construction of meaning about a particular topic’’ (p. 30). Fontana and Frey (1994) note that taking part in interviews is one of most frequent methods used to understand others. According to Kadushin and Kadushin (1997) an interview may be defined as ‘‘ a conversation with a deliberate purpose that the participants accept… [resembling] a conversation in many ways [and involving] verbal and nonverbal communication between people during which they exchange ideas, attitudes and feelings’’ (p. 4). Creswell (2012) defines interviews as what occurs when researchers ask one or more respondents general, open-ended questions and record the answers, and where the researcher converts and types the data into a computer file for analysis. Cohen et al. (2011) see the interview as a social and an emotional encounter, not merely a process of data or information collection. Interviews, in the view of Denscombe (2010), have several advantages: for example, they are good at producing data in depth and detail; require simple equipment; allow flexibility and adjustments as they proceed; ensure a relatively high response rate because the interviews can be prearranged at a convenient time and location; and validity, because in their direct contact the data can be checked for accuracy and relevance. As Denscombe states, before a programme of interviews can be begun, the researcher has to be assured that s/he can have direct access to the specific interviewee(s) and that agreement can be obtained from all the respondents involved in the research; furthermore, the researcher needs to be sure that the respondents are not widely distributed across a large geographical area, since that will involve high costs (Denscombe, 2010).

There is no single right way of interviewing, no single correct format that is appropriate for all situations and no single way of wording questions that will always work. The particular situation, the needs of the interviewee and the personal style of the interviewer all come together to create a unique situation for each interview (Patton, 1990).

The advantages and disadvantages were taken into account when designing the interview questions. In this study three sets of interview questions were compiled: for the science teachers who taught grades six and seven, for their students in grades six and seven, and for those who worked to reform the science curriculum. The aim of the teacher and student interviews in this study was to explore what they thought of the new science curriculum in various respects, for example the reform process, reform participants, new science curriculum and socio-cultural context, the new curriculum and religion, its content, objectives, student assessment, teaching and learning challenges, activities for learning and instructional tools. In addition, the interviews with the reformers aimed to explore their views about the science curriculum reform process, aims, phases, challenges, participants, implementation and others.

Among the types of interviews, as described by Cohen et al., (2011) are structured ones, semi-structured, non-directive and focus group. According to Denscombe (2010) the types consist of structured, semi-structured, unstructured, one-to-one and focus group interviews. In this study, the two types used were semi-structured (for the interviews with science teachers and science curriculum reformers) and semi-structured focus group interviews (for students). These are described in turn below.

#### 4.6.2.1 Semi-structured interview

In this study semi-structured interviews were held with the science teachers who taught the sixth and seven grades and the science curriculum reformers, who reformed the science curriculum for these grades. According to Oates (2006), semi-structured interviews require the interviewer to ‘‘[make] use of lists, including questions and information in the search for answers. This type of interview is flexible for both interviewer and interviewee.’’(p.187). In a semi-structured interview, Denscombe (2010) notes, ‘‘the interviewer still has a clear list of issues to be addressed and questions to be answered’’ (p.176). Semi-structured interviews are useful for investigating defined topics and ensuring that the interview obtains results, whilst also providing the respondent with freedom of expression so that all topics are addressed (Newby, 2010). Meanwhile, the interviewer is prepared to be flexible in terms of the order in which the topics are considered and, perhaps more significantly, to let the interviewee develop ideas and speak more widely on the issues raised by the researcher. The answers are open-ended and there is more emphasis on the interviewee as s/he elaborates points of interest. However, the disadvantages of this type are mainly the need to spend a long time on reviewing the respondents' responses, estimating their power to provide explanations and qualitatively analysing them (Hesse-Biber and Leavy, 2010).

The choice of semi-structured interviews in this study was made for many reasons: to leave the interviews open for any new questions and ideas that they might elicit and to let the interviewer add to or change any question within the interview. This type of interview was also chosen to leave the participants more free to elaborate on their ideas and views, which could be discussed at the time. The interview questions were designed after the relevant literature and previous studies had been reviewed and took into account the aims, research questions and SCT basis of this study. The interviews consisted of several open-ended questions, details of which are in Appendices (3&5). During the interview, in order to make sure that the teacher understood the questions and to be assured of the relevance of their answer, the researcher sometimes asked the teacher to provide clarification or an explanation of an answer, saying for instance 'What do you mean . . . by saying . . .?'. This was in order to make the results clearer and more credible, and was also done with the students through the focus group interviews which are discussed in the next section.

#### 4.6.2.2 Focus group interview

The focus group interviews were used to interview groups of students from grades six and seven. In general, a focus group interview is ''the process of collecting data through interviews with a group of people, typically four to six'' (Creswell, 2012, p. 218). The focus groups were used in this study for many reasons: they were a method of interviewing the largest possible number of students, encouraging them to discuss with each other their views of and ideas about the new science curriculum so as to yield more in-depth data, to be open to any new ideas, views and question that might be encountered and to give the students the freedom and confidence to speak their minds.

According to Cohen et al. (2011), focus groups are contrived settings, collecting a chosen sector of the population to discuss a particular subject or problem. Specifically, their most important feature is the focus of the session, with the group discussion being based on an item or experience about which all participants have similar knowledge and the particular concentration placed on the interaction within the group as a means of eliciting information; and the role of the facilitator is to pave the way for group interaction (Denscombe, 2010). Thus, the advantages of using focus group interviews can be directed to a particular field of focus, such as generating hypotheses, collecting qualitative data quickly and cheaply, on attitudes, values and opinions (Cohen et al., 2011). According to Denscombe (2010), it provides depth through the interview and enables the researcher to ask a variety of questions and explore the answers as they arise. Therefore, focus group interviews are important when interaction between the respondents will be likely to yield the best information and when the respondents are similar to and connected with each other; when the time to gather information is restricted, and when individuals are hesitant to provide information (Creswell, 2012).

The focus interviews questions, like the others, were also designed after the relevant literature and previous studies had been reviewed and took into account the aims, research questions and SCT of this study. They were reviewed when they had come back from the translators, (before the pilot) and again after the pilot. For more details of the focus group interview questions see Appendix (4).

#### 4.6.2.3 Pilot study of interviews

Semi-structured and focus group interviews were piloted before the main study. According to Yin (2003), ‘‘the pilot study will help you to refine your data collection plans with respect to both the content of the data and the procedures to be followed’’ (p.79). The main aim of a pilot study is to discover ahead of time the imperfections in the proposed experimental design or mechanism, which can then be revealed before too much in the way of time and resources has been used and thus reduce the risk of failure in large scale studies (Maxwell, 2005). The purpose of the piloting the interviews in this study was to identify the time needed to complete the interview; to define any problems from the arrangements for the interviews; to avoid such difficulties and problems in the future, to introduce my research to the interviewees, to discover the weaknesses in the interview planning and to have practical experience of interviewing. In this study the interview questions for the teachers, students and reformers were translated from English into Arabic and handed to four specialists in language and translation at the University of Kuwait's English Department for review and to have the translation checked. The interview questions were then handed to three academics in the Faculty of Basic Education in Kuwait and two from the School of Education in the University of Kuwait for comment on whether these questions had met the objective for which they had been designed. They were then piloted in interviews with two science teachers (one male and one female) and two focus groups of students (one group of five boys and another of five girls). The respondents all came from four schools selected at random. In addition, one of the science curriculum reformers took part in the pilot. After each interview of a teacher, student or reformer the interviews were transcribed and presented to the all participants again for their accuracy to be checked; this helped me to check the reliability of my methods. This pilot study was useful in giving me practical experience before the main study; it helped me to develop and add some interview questions. In addition, it helped me to explore ways to meet some challenges. For example, it took a long time to arrange interview times, since the reformers were generally very busy, so I took all these issues into account in the main research effort.

### 4.6.3 Classroom observation

I visited the science classes of the sixth and seventh grades to observe what went on. Observation is defined as ''the process of gathering open-ended, firsthand information by observing people and places at a research site'' (Creswell, 2012, p. 213); while the term is defined by Denscombe (2010, p206) as something that

> *...offers the social researcher a distinct way of collecting data. It does not rely on what people say they do, or what they say they think. It is more direct than that. Instead, it draws on the direct evidence of the eye to witness events first hand. It is based on the premise that, for certain purposes, it is best to observe what actually happens.*

According to Wragg (2012), ‘‘classroom observation is now becoming far more common than it once was’’ (p.2). Wragg indicates several purposes of classroom observation such as observing students’ activities, the relationship between teacher and students, class management, learning activities and teaching methods. It needs good listening skills and careful attention.

The classroom observations in this study aimed to observe and understand the teaching and learning of the new science curriculum in the classes under review. Observational categories were created to observe the learning activities and teaching methods which are used in science classes, the students’ behaviour in the science classes, the instructional tools that were used with the new science curriculum, the classroom size, classroom facilities and classroom suitability for the lessons being taught, and the science lesson durations. The SCT as the theoretical framework was helpful as guidance during the observations to understanding the process of teaching and learning science regarding the SCT, and helpful for the discussion of the observations data. For example, the SCT was used as the guidance to observe the learning activities and role of the teacher and students in these activities and to what extent the social interaction and cooperative groups are used for the teaching and learning of science.

There are many advantages of observation from which I wanted this study to benefit. Among its advantages (Denscombe, 2010) are that it gathers data in a direct way, is an efficient tool with a high level of reliability and validity and uses basic instruments. Moreover, Creswell (2012) sees advantages in the opportunity that it gives to record data as it happens in its own setting, to study actual behaviour and to study respondents who may have difficulty explaining their ideas. Furthermore, as Cohen et al. (2011) state, observation concentrates on live data and situations and it is not theory-driven, nor predetermined.

In contrast, Creswell (2012) lists the disadvantages of observation, which must be limited to the sites and situations where access can be gained, and in these situations it may be hard to develop connections with the respondents, which occurs whether or not the respondents are accustomed to formal research.

These advantage and disadvantages were taken into account when designing the observation tool to collect the data and when the classes were under observation. This tool is a form which was used to collect and summarise the relative occurrences of different events or actions in a classroom. The form included the checklist and spaces were provided for comments which allowed the researcher to describe unanticipated situations and events that happened in the classroom. The form contained certain basic information, including the name of the school, gender, class, subject, number of students, date, time and location (see Appendix 7).

Two types of observation technique may be used in the observation process, which are described by Creswell (2012) as non-participant observation and participant observation. In the former the observer 'visits a site and records notes without becoming involved in the activities', while in the latter, the observer 'truly learns about a situation,' and 'can become involved in activities at the research site' (Creswell, 2012, p.214). According to Yin (2003), in participant observation the observer can join in the observed activities and in non-participant observation s/he observes but takes no part in what is going on. Non-participant observation was the type used in this study. I sat at the back of the classroom to observe the teaching and learning of lessons in the science course and took field notes without participating at any stage in the class activities.

#### 4.6.3.1 Pilot study of observation

As noted above, a pilot study is important for gaining practical experience and exploring the challenges in advance of the main study. The advantage of a pilot study lies in its indicating weak points of the research project and the procedures that might not succeed; moreover it shows up the practical problems and suggests which procedures or tools are appropriate or inappropriate (Glitz, 1998). Cohen et al. (2011) indicates that the observation ''pilot [should] have been conducted to ensure that the observational categories themselves are appropriate, exhaustive, discrete, unambiguous and effectively operationalise the purpose of the research'' (p.210). I planned to observe two classes, taught by the two science teachers who had already participated in the pilot interviews. I had noted in the pilot observation that some students asked the teacher about me and some asked me why I was visiting their class, so it was important to present myself and the purpose of my visit beforehand. This pilot observation was also useful for preparing me, my method of recording observation notes and a protocol of classroom observation for the main study.

### 4.6.4 Validity and reliability of the interview and observation methods (qualitative)

In this section the validity and reliability of the interviews and classroom observations are discussed. Qualitative validity is ‘‘the extent to which qualitative researchers can demonstrate that their data are accurate and appropriate’’ (Denscombe, 2010, p.297). In addition, Cohen et al (2011, p.204) indicate that the best way to achieve greater validity is by minimising as much bias as possible. The sources of bias are the characteristics of the interviewer and interviewee and the substantive content of the interview questions. They include:

- The attitude and opinions of the interviewer.
- A tendency for the interviewer to see the respondent in his or her own image.
- A tendency for the interviewer to seek answers that support preconceptions, which lead to misperceptions of the respondent's answers.
- Misunderstanding on the part of the respondent of the questions asked.

But as Patton (2002) stipulates, reliability and validity are important for any researcher to be concerned about in designing a study, analysing results and judging the quality of research. According to Joppe (2000), ‘‘Reliability is the extent to which results are consistent over time and an accurate representation of the total population under study is referred to as reliable, [while]... Validity determines whether the research truly measures that which it was intended to measure or how truthful the research results are.’’ (p.1).

In this study all the interview questions and observation tools were distributed to five experts and specialists in science curriculum reform and development from Kuwait University and the College of Basic Education in Kuwait to check and review the validity: did these interview questions measure what they claimed to measure? The feedback received was limited to re-writing some questions to be clearer, and change the emphasis in some other questions. An example of a question changed in the teacher interview is: *Do you use the instructional tools in all science classes?* to be, *Is the new curriculum encouraging you to use the instructional tools?* Based on the feedback obtained from them, the recommended modifications were carried out. In addition, all the data collection tools were piloted and after each interview and classroom observation the transcripts and field notes were presented to all the participants, (teachers, students and reformers) for their scrutiny, criticism and confirmation that their responses had been noted accurately. Many authors and researchers confirm that triangulation is one of the best techniques available to ensure the quality, validity and reliability of a study (Cohen et al, 2011; Creswell, 2012; Denscombe, 2010; and Patton, 2002).

Patton (2002) states that ‘‘triangulation strengthens a study by combining methods. This can mean using several kinds of methods or data, including… both quantitative and qualitative approaches.’’ (p.247) A methodological triangulation approach as described by Cohen et al. (2011) was used in this study; this considers either a single method used on different participants or uses different methods on the same object of study. Denscombe (2010) adds that the main benefits accruing from methodological triangulation are the ability to corroborate findings by comparing the data produced by different methods, complement a finding by adding something new and different from one method to another and improve the validity and reliability of the study. Further, ‘‘methodological triangulation removes bias and misrepresentation from samples which may affect the eventual findings of the research’’ (Mathison, 1988, p. 15).

In this study, to ensure the quality of the interpretive paradigm, methodological triangulation was used, such as the triangulation of methods of data collection (questionnaire, interviews and observation) and triangulation of the participants (teachers, students and reformers).

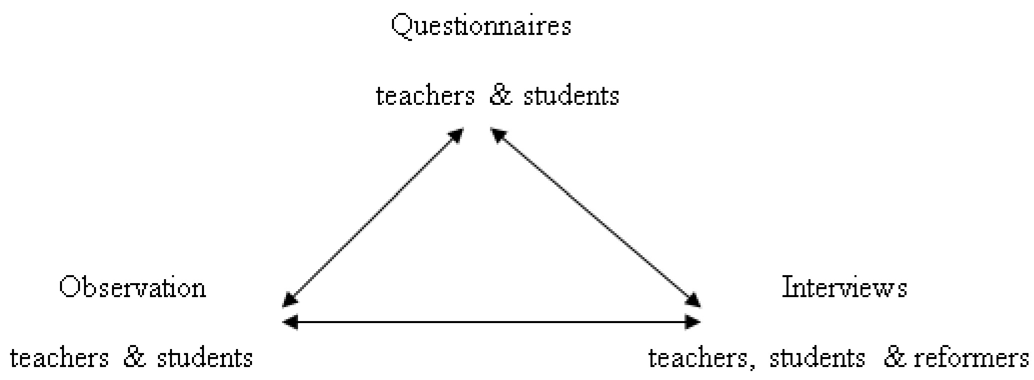



Figure 4.1 Triangulations of methods of data collection and participants

### 4.7 Population and Sampling

The definition of a population is critical for any social science enquiry. The ‘‘population from which the sample is drawn must be consistent with the population of interest for the study’’ (Henry, 1990, p. 103). Gorard (1999) distinguishes between a population and a sample as follows: ‘the group you wish to study is termed the ‘population’ and the group you actually involve in your research is the ‘sample’ (p. 10). The participants in the current study were drawn from a population which consisted of science teachers and students in grades six and seven at public schools and the science curriculum reformers in the Ministry of Education. There are two potential sampling methods to use, namely, probability and non-probability sampling (Creswell, 2012). A probability sample tries to be representative of the whole population. A non-probability sample is used when the researcher may not be able to give an accurate representation of the total population (Creswell, 2012). In this study the researcher knew a certain amount about the whole population of teachers, students and reformers, so the probability sampling method was used in this study, together with the techniques and strategy discussed below.

Different strategies can be used for selecting the sample, such as random, systematic, stratified, cluster, stage, multi-phase, convenience, quota, purposive, dimensional, snowball, volunteer and theoretical sampling (Cohen et al., 2011). Selecting the proper sampling strategy depends on the research aim, problem and questions and ‘‘in some studies, it may be necessary to use several different sampling strategies’’ (Creswell, 2012, p. 207).

The sample for this study was selected by using different sampling strategies in different phases; it needed a questionnaire sample first, then an interview sample and finally an observation sample (Figure 4.2).

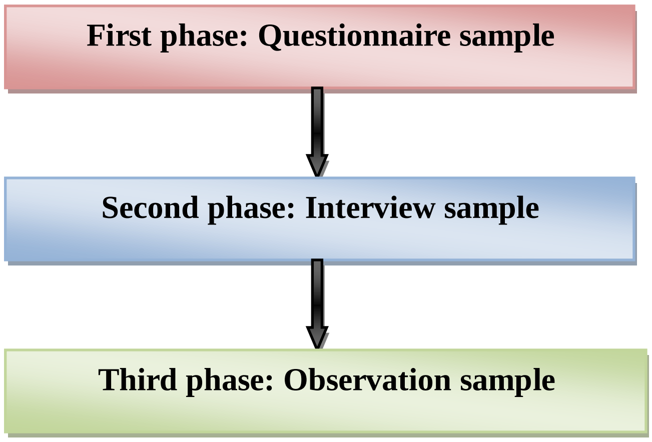



**Figure 4.2** Sampling phases of the current study.

These phases and sampling strategies are discussed in detail in the following sections.

### 4.7.1 Questionnaire sample

The first phase of the current research sampling needed questionnaire samples to be chosen. The schools from which the samples (of teachers and of students) for the two questionnaires came were selected at random from the list of 201 intermediate stage schools in the State of Kuwait, initially obtained from the MoE in Kuwait. I drew slips of paper at random to ensure that all the boys' and girls' schools would have the same chance of being selected (the fishbowl draw method). I continued without looking at the names of the schools until 10 boys' schools and 10 girls' schools had been chosen. Further details of the sample are explained below.

#### 4.7.1.1 Teacher questionnaire sample

The sample yielded 310 science teachers (168 male and 142 female). Their questionnaire was distributed to the teachers who teach grades six and seven in the intermediate stage at Kuwaiti public schools.

**Table 4.6** Sample distribution showing the teachers' grades, whether they had taught the old curriculum, their gender, position, years of experience, last degree and specialisation.

| Variable | Sub-variables | Number | percentage % |
|---|---|---|---|
| Grade | Sixth Grade | 79 | 25.5 |
| | Seventh Grade | 85 | 27.4 |
| | Both | 146 | 47.1 |
| Taught the old science curriculum | No | 52 | 16.8 |
| | Yes | 258 | 83.2 |
| Gender | Male | 168 | 54.2 |
| | Female | 142 | 45.8 |
| Position | Teacher | 271 | 87.4 |
| | Head Teacher | 38 | 12.3 |
| Length of teaching experience | 2-5 yrs | 84 | 27.1 |
| | 6-10 yrs | 107 | 34.5 |
| | 11-15 yrs | 54 | 17.4 |
| | 16-20 yrs | 34 | 11.0 |
| | > 20 yrs | 31 | 10 |
| Last degree obtained | Bachelor's | 299 | 96.5 |
| | Master's | 10 | 3.2 |
| | Doctorate | 1 | 0.3 |
| Specialisation | Science Education | 197 | 63.5 |
| | General Science | 35 | 10.0 |
| | Physics | 19 | 6.1 |
| | Chemistry | 24 | 7.7 |
| | Biology | 24 | 7.7 |
| | Geology | 11 | 3.5 |
| **Total** | | **310** | **100%** |

### 4.7.1.2 Student questionnaire sample

The student questionnaire sample comprised 647 students (410 boys and 237 girls) from grades six and seven in the intermediate stage at Kuwaiti public schools.

**Table 4.7** Sample distribution according to student gender and grade

| Gender | | Grade | | Total |
|---|---|---|---|---|
| | | Sixth | Seventh | |
| **Boys** | Count | 195 | 215 | **410** |
| | Percentage % | 47.6 | 52.4 | **100.0** |
| **Girls** | Count | 117 | 120 | **237** |
| | Percentage % | 49.4 | 50.6 | **100.0** |
| **Total** | Count | 312 | 335 | **647** |
| | Percentage % | 48.2 | 51.8 | **100.0** |

### 4.7.2 Interview sample

The sample for interviews comprised science teachers, students from grades six and seven and reformers who had worked on the science curriculum reform. The interviews were arranged as follows: eleven semi-structured interviews with individual science teachers (seven male and four female), six students' focus group interviews (five students in each group, a total of 30) and nine semi-structured interviews with individual reformers.

#### 4.7.2.1 Teacher interview sample

The questionnaire helped me to select the sample for interviews. In the last part of their questionnaire, the teachers were asked if they wished to participate in personal interviews. Any interested teacher could write his or her telephone number and email address to be contacted for an interview. After collecting the questionnaires, I found that only 38 teachers out of the 310 had agreed to be interviewed. I reviewed and analysed their questionnaire answers and then picked members of this group according to their answers (positive, negative, mixed), gender, experiences, position and specialisation because the aim of the study was to explore the teachers' views about the new science curriculum and therefore samples from different contexts/categories would be useful. I also wanted to ensure interviews with a heterogeneous group of teachers so as to have richer and more credible data. Thus, I contacted 15 of them and finally arranged to speak to a sample of 11 teachers from different categories (as discussed above). More details of these participants are shown below in Table (4.8).

**Table 4.8** Sample details of the science teachers interviewed

| Interviewees | Gender | Position | Experience | Specialisation | Interview duration |
|---|---|---|---|---|---|
| **Teacher (1)** | Male | Teacher | 5 years | Chemistry | 1:05 hrs. |
| **Teacher (2)** | Female | Teacher | 17 years | S. Education | 1:00 hrs. |
| **Teacher (3)** | Female | H. Teacher | 20 years | S. Education | 1:05 hrs. |
| **Teacher (4)** | Male | Teacher | 8 years | Biology | 1:18 hrs. |
| **Teacher (5)** | Male | Teacher | 12 years | G. Science | 1:10 hrs. |
| **Teacher (6)** | Female | Teacher | 7 years | S. Education | 1:15 hrs. |
| **Teacher (7)** | Male | H. Teacher | 23 years | S. Education | 1:12 hrs. |
| **Teacher (8)** | Male | Teacher | 14 years | G. Science | 1:00 hrs. |
| **Teacher (9)** | Female | Teacher | 12 years | Physics | 1:10 hrs. |
| **Teacher (10)** | Male | H. Teacher | 16 years | G. Science | 1:20 hrs. |
| **Teacher (11)** | Male | Teacher | 9 years | Geology | 1:05 hrs. |

H. Teacher: Head Teacher; S. Education: Science Education; G. Science: General Science

#### 4.7.2.2 Student interview sample

The sample of teachers who were interviewed helped me to select a sample of student interviewees because they were familiar with the students than and would help obtain rich and credible data for the survey, as well as giving the largest possible number of students the chance to discuss their views. I asked all eleven teachers interviewed to select a group of five of their students who would represent different levels of science learning or science scores (excellent, very good, good), different levels of activeness in the science class and different attitudes to science. The teachers nominated 11 groups of students, 55 in total from different schools (7 boys' groups and 4 girls' groups). I then contacted the managers of all these schools by phone to arrange the interviews and then I visited all these schools to distribute the parents' consent letter to all these students. Finally after contacting of all these schools of these students, I found some difficulties with arranging interviews with some of the girls for reasons related to Kuwait traditional, religious and social culture because some female teachers and parents of girls prefer them not to work or sit with any man; for these reasons I made a final choice of the students to interview. They fell into 6 groups, 4 of boys and 2 of girls, with 5 students in each group. The details of this sample are shown in Table (4.9) below.

**Table 4.9**: Sample details of the students' focus group interviews

| Interviewees | Gender | Grade | Interview duration |
|---|---|---|---|
| **Group (1)** | Boys | Seven | 1:00 hrs. |
| **Group (2)** | Boys | Six | 1:00 hrs. |
| **Group (3)** | Boys | Seven | 1:05 hrs. |
| **Group (4)** | Girls | Six | 1:00 hrs. |
| **Group (5)** | Boys | Six | 1:00 hrs. |
| **Group (6)** | Girls | Seven | 1:05 hrs. |

### 4.7.2.3 Reformer interview sample

Fourteen reformers were approached, who had taken part in the reform of the science curriculum for grades six and seven. I contacted all of them to ensure that they would all have the chance to participate in this study (see section 4.8.2, second phase, below). Nine of them were able to participate in this study; their details are explained in Table (4.10).

**Table 4.10:** Sample details of the curreculum reformers' interviews

| Interviewees | Position | Interview duration |
|---|---|---|
| **Reformer (1)** | Science inspector | 1:25 hrs. |
| **Reformer (2)** | Science inspector | 1:15 hrs. |
| **Reformer (3)** | Curriculum sector staff | 1:00 hrs. |
| **Reformer (4)** | Science inspector | 1:05 hrs. |
| **Reformer (5)** | Curriculum sector staff | 1:10 hrs. |
| **Reformer (6)** | Science inspector | 1:00 hrs. |
| **Reformer (7)** | Science inspector | 1:00 hrs. |
| **Reformer (8)** | Science inspector | 1:10 hrs. |
| **Reformer (9)** | Science inspector | 1:00 hrs. |

#### 4.7.2.4 Classroom observation sample

The science teachers' interviews helped me to choose which classrooms to observe. After each interview with a teacher, I asked him/her if I could visit their class in order to observe the teaching of the new science curriculum inside the classroom. Only 9 out of 11 teachers agreed. I was keen to select the classes of teachers who had different views about the curriculum. I chose to observe some teachers who were satisfied with the new science curriculum, some who were not and others who had a neutral view in this regard. I was also careful to choose male and female teachers who had varying amounts of teaching experience, both teachers and heads of departments. I contacted the teachers to arrange the visits and finally went to four different classrooms under four different teachers, observing each 2-3 times and remaining in each for the full 45 minutes, the class duration in the Kuwaiti education system. The details are shown in Table (4.11) below.

**Table 4.11:** Sample details of the classroom observation

| Observations | Gender | Grade | Number of observations | Location |
|---|---|---|---|---|
| **Observation (1)** | Boys | Sixth | 3 | Classroom |
| **Observation (2)** | Girls | Sixth | 2 | Classroom & Science lab |
| **Observation (3)** | Boys | Seventh | 2 | Classroom & Science lab |
| **Observation (4)** | Boys | Seventh | 3 | Classroom |

### 4.8 The design of the study

In this section the procedures for the primary data collection are discussed. They fell into three main phases, starting from the questionnaires, interviews and finally classroom observation.

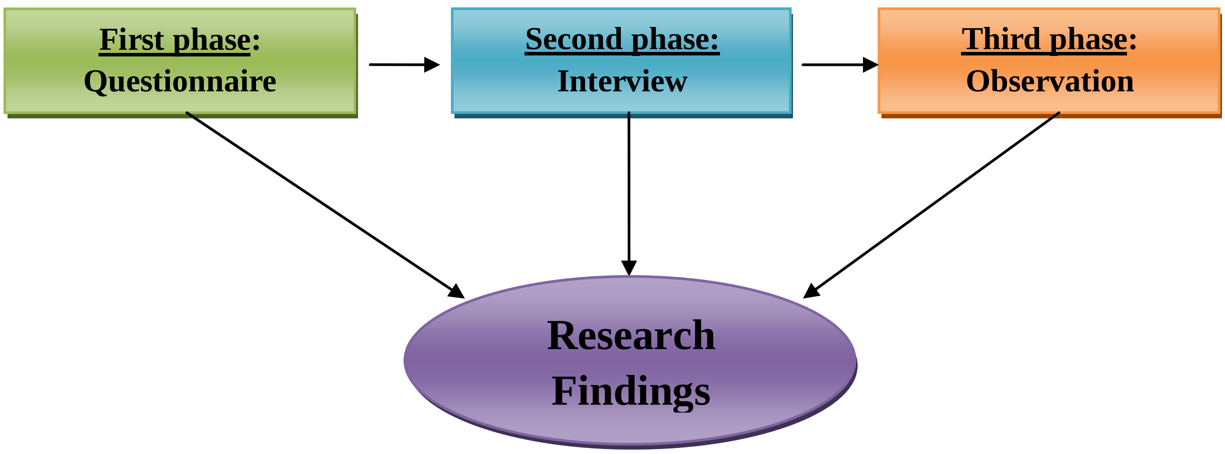



**Figure 4.3**: The design of the study.

### 4.8.1 Obtaining permission

For the first round of data collection before the pilot and main study, I obtained all the approval and permission needed to carry out my study. First, a Certificate of Ethical Approval from the Graduate School of Education at the University of Exeter was completed and agreed by the university (Appendix 10). This certificate included some information about the research project, research aims, participants and ethical issues that needed to be taken into consideration throughout this research. Second, I received permission from the Kuwaiti Cultural Office in London to conduct my study in Kuwait. Third, I obtained approval from my sponsor, the Public Authority for Applied Education and Training (PAAET), to collect data from the teachers, students and reformers (Appendix 11). Finally, I was allowed by the MoE to visit the intermediate schools in Kuwait and carry out the questionnaire distribution, interviewing and classroom observation that my study required (Appendix 12). I offered to show these letters to all the respondents. To save time, I secured all these letters two months before the main study began.

### 4.8.2 The main study

The process of collecting data for the fieldwork started in January, 2012 and lasted until June 2012; i.e., five months were needed to collect all the primary data. As noted above, the primary data were collected in three phases, which are discussed below.

**First phase: Questionnaire**

I went to all the schools which had been randomly selected (see section 4.7.1) and provided each school manager with a letter issued by the Ministry of Education, which permitted me to conduct the questionnaire. Then I was taken to see the head of the science department. The principals were happy to cooperate and introduced me to the science teachers. I then described the purpose of the questionnaire. I explained that this questionnaire was part of my research, that all answers would be kept confidential and that the results would be used in my doctoral thesis.

I also briefly explained how to answer the teachers' questionnaire and in some schools I waited for the teachers to finish their responses. I also explained to the students in the classes how to respond to the student questionnaire. Because of the large number of students, in some schools (for instance, the 5 girls' schools) the teachers helped me to distribute the students' questionnaire sheets because due to Kuwait's traditions and culture it was sometimes difficult for me to enter a girls' classroom. In most of the 7 other schools, however, I distributed them by myself. I discussed the students' questionnaire with the teachers and explained to them how the students should complete the questionnaire. I also gave them my mobile number so that they could be in touch and contact me at any time if they had any questions.

I also distributed the questionnaires to all the teachers in the 10 boys' and 10 girls' schools in which the administration allowed me to enter the classrooms for this purpose and present some explanations. I listened to their comments and inquiries while they were responding to the questions and subsequently collected the questionnaires.

Although I was confident that the questions were answered carefully by both teachers and students, I found that this method also helped me to observe how students and teachers answered these questions, what difficulties they encountered in the process and how these difficulties might be resolved.

The collection of questionnaire sheets after completion differed from one school to another. The head of the science department in each school was responsible for contacting me, scheduling a date and handing back the questionnaires. From some schools I collected the questionnaires on the same day, while some contacted me next day for this purpose and other schools took more than a week. I received 342 teacher questionnaires and 661 student questionnaires. After reviewing them, I found that some questionnaires were incomplete and therefore excluded them. This left 310 teacher questionnaires and 647 student questionnaires. The questionnaire phase took in all 35 days from distributing the questionnaire until the last sheet had been collected from the last school.

**Second phase: Interviews**

After collecting all the questionnaires, the next phase was to interviews the science teachers and students. This section discusses the two types of interview, namely, the science teachers' semi-structured interviews and the student focus group interviews.

**a) Teacher interview**

I contacted by phone all the teachers who had been selected for interview and introduced myself, explained the goal of the proposed interview and asked them to schedule a time and place for it. Then I called the teacher the day before to confirm the arrangements. At the beginning of each interview I introduced myself to the teacher and explained the purpose of the interview, assured him or her that all information would be kept confidential, guaranteed anonymity throughout the study and clarified that he or she had the right to refuse to answer any question and could withdraw from the interview at any time. I provided all this information in writing and asked him or her to sign it and keep a copy (Appendix 13).

All the teacher interviews except one were conducted in the school in an enclosed and quiet space available; the exception was conducted in a teacher’s house, and was in an enclosed and quiet space. In each interview, I brought water and biscuits to make the teacher feel more comfortable. I asked and was allowed by all the teachers to record the interviews on an audio recorder. These interviews took between 1 and 1:20 hrs each.

There were some difficulties in the scheduling of dates with teachers, with female teachers in particular. Some principals of the girls’ schools refused to allow me to conduct any interview within the school, because Arabic and Islamic customs generally forbid men to enter girls' schools. Some teachers refused to be interviewed despite having agreed to do so and others scheduled a date which they later cancelled.

After each interview, I transcribed the teachers’ answers and later emailed it to the interviewee to make sure that their answers reflected what they meant. I received further comments from some teachers on their answers.

Interviews with the education reformers were conducted at around the same time as the interviews with the teachers. I met a group of teachers to start with, then met a group of reformers, then interviewed another group of teachers, and so on. This method helped me considerably in the transfer of views between the teachers and reformers about the new science curriculum, as one of the goals for the interview was to identify the extent of the Ministry of Education’s cooperation with teachers and the extent of the teachers' participation in curriculum development. Given the fact that I used social-culture theory and intended to analyse the process of teaching and learning the science curriculum regarding the SCT, it was valuable to have conveyed the teachers' views to what extent the science curriculum took into account the student, social-culture, religion, needs and daily life. For example, some reformers claimed that the current curriculum was adapted carefully to taken the student social-culture into account. I conveyed this statement to a group of teachers, who would not accept it but complained of the lack of relationship, so I reported this complaint to the reformers when I returned to meet them.

In addition, this method helped me to understand the relationship between the MoE and the teachers and the extent of cooperation between the MoE and teachers. It also helped me to deliver different views to all the parties concerned, listen to their responses and insert more questions at the end of each interview. Some additional questions were raised after listening to the different views, for example the question for the reformer interview, *Did you explore or ask for the teacher views about the new science curriculum, now after two years of this curriculum implemented? Why?*

**b) Student interviews**

After selecting the students' sample for the focus interviews, I visited their schools and distributed a letter of approval in order to obtain permission from the students' parents to conduct interviews (Appendix 14). A parent needed to sign to give consent and then to give the form to the student who would return it. This letter included a brief personal introduction, the purpose of the interview, an assurance of the confidentiality of the information given in the interview and my telephone number and email for any inquiries. I asked the students to submit the signed paper to the school manager, who would then call me.

Interview dates were arranged through the school managers. Each interview was conducted in a quiet and convenient place in the school. I asked the students questions and gave them all a chance to reply and discuss their answers. All the student interviews were recorded. I asked the students to expand on some of their answers so that I could better understand what they meant by their responses and thus ensure that they had correctly interpreted the question. In some cases, I repeated their answer back to them to ensure that it was the answer they intended to give.

After each interview I made a transcript of the group of students' answers and on my next visit to the school discussed their answers with those students to ensure that their answers reflected what they had meant. This was helpful in giving the data more credibility. The same problem was encountered in the girls' schools as with the female teachers. Not all the school managers agreed to my visiting the school to conduct interviews with girls, for the reasons mentioned above. The students' interviews took from 1.00 to 1.05 hours each.

**c) Reformers' interviews**

The education reformers who had engaged in the reform of the new science curriculum were selected by reviewing the studies, research and official documents from the MoE which gave these people's names. I specified the names before conducting the main study and visited the MoE, Curricula Development Sector to verify the correct names of these persons.

All the participants in the reform of the curricula were officials of the MoE, such as the Minister, Assistant Under-Secretary, or Science Inspector, as well as members of staff from the Curricula Development Sector. The Assistant Under-Secretary for the Curricula Sector took over the supervision of the curriculum development process. After listing the names of the 14 selected persons, I visited them at their workplace and gave them each a letter which requested their cooperation in the interview process. Most of the education inspectors were working in the same location, which helped me to interview a number of them.

I met the reformers at work and explained the purpose of the interview to them. I briefly described my academic study and its aims. Dates were set to conduct personal interviews with 11 people who had worked on the curriculum reform. All the interviews were conducted in their offices and workplaces. I was careful to provide a quiet place, where I carried out each interview, using audio recording.

The same measures as for the teachers' interviews were taken for the interviews with the reformers to ensure the relevance of their answers and that they correctly understood the questions. I asked for additional explanation and clarification of some of their answers. After each interview, I presented them with a written copy of what they had said to ensure that they meant what had been transcribed as their answers.

**Third phase: Observation**

After each teacher interview, I asked to attend their class in order to observe the teaching of the new science curriculum in the classroom. I explained that the goal of this visit was to observe the teaching methods and instructional tools which were used, the extent of student participation and interaction with science in the classroom, how the teacher explained the lesson and managed the class and the adequacy of the time allocated for the lesson.

According to the MoE, I had to obtain prior consent from the school manager in order to visit classes. Therefore, I contacted the managers of the schools which allowed me to observe their classes. In view of the habits and traditions, in particular as regards visits to the girls' schools, some female teachers or the female managers of their schools made it difficult to gain approval for my visits.

Eventually, for several reasons including time, the disapproval of some teachers or rejection by a school manager, I carried out four sets of classroom observations (three boys' classes and one girls' class) and observed each class 2-3 times, so the total of all my classroom observations was 10 ( see section 4.7.2.4). Before every observation, I sat with the teacher to learn about the lesson to be given, identified its objectives and discussed some associated issues, such as the teaching tools and methods.

At the start of each observation, I introduced myself to the students and briefly described my reason for attending their class. I sat in a rear desk that allowed me to see the whole classroom. I did not get involved in the lesson, but only noted whatever occurred in the classroom. I took some pictures of the classrooms and science labs to show facilities such as: new technology tools, class and lab size and design and students' desks design distribution.

After each observation, I sat with the teacher to discuss some remarks that I had noted in the class, such as the teaching methods applied, tools, learning activities, participation of the students in activities and how the time was allocated to complete the lesson on time. I also discussed with the teachers the field notes of each visit.

Sometimes, after the class ended, I sat among the students, asking them questions about the lesson in general, such as what they had learned and what difficulties they faced and I listened to their suggestions. This method helped me to establish an excellent relationship with the students, who started to talk freely with me after the second or third observation, as they became comfortable with my presence.

### 4.9 Data Analysis

This section discusses the data analysis tools and techniques which were used to analyse the data collected from the questionnaires, interviews and classroom observations. Two analysis tools and techniques used in this study were the SPSS (Statistical Package for the Social Sciences) computer program for the quantitative data which were collected from the teachers' and students' questionnaires, and thematic analysis of the words of the teachers, students, reformers, the classroom observations and the answers to the open-ended questions in the questionnaire. These tools and techniques are described in turn below.

#### 4.9.1 Quantitative data analysis

The quantitative data were analysed using SPSS (Statistical Package for the Social Sciences version 18). Computer statistical packages help make the research process accurate and quick, allowing researchers to carry out more tests and thus obtain greater insight (Scott & Morrison, 2006, p. 34). SPSS is one of the most effective packages, due to its tailored interface which is designed to allow the analysis of a range of variables without rekeying or reformulating statistical tests (Muijs, 2011). Bryman & Cramer (2005) add that: ‘‘The great advantage of using a package like SPSS is that it will enable you to score and to analyze quantitative data very quickly and in many different ways’’ (p.16). In this study the data in the teachers' questionnaire was analysed separately from those in the students' questionnaire and two SPSS files were used, one for each set of data. The first phase of the quantitative analysis was to number all the questionnaires. Then all the questionnaire variables, questions and items were coded to transform the raw data into numerical data suitable for entry to an SPSS file; for example, for the grade variable the sixth grade students' answers were given code (1) and those of the seventh grade students were given code (2). After this, the responses of the participants were entered in the SPSS file and then the data were analysed. The results and the tests which were used are presented and explained in the next chapter (Chapter Five: Quantitative analysis).

### 4.9.2 Qualitative data analysis

In this section the qualitative data which were collected from the interviews, observations and the open-ended questions of the questionnaire are discussed. In this study thematic qualitative analysis was used to create networks, which Braun and Clarke (2006) indicate is ''a method for identifying, analysing and reporting patterns (themes) within data'' (p.6). Attride-Sterling (2001) defines these networks of thematic material as ''a way of organizing a thematic analysis of qualitative data. Thematic analyses seek to unearth the themes salient in a text at different levels and thematic networks aim to facilitate the structuring and depiction of these themes. Clearly, the process of deriving themes from textual data and illustrating these with some representational tool is well established in qualitative research.'' (p.387). In addition, one of the advantages of the thematic analysis approach is its flexibility; this makes it a very useful tool, providing rich, detailed information on very complex issues.

The thematic analysis is done in different phases; for example, as the Attride-Sterling 2001 explains six phases in thematic analysis: the first phase is coding the data; second, identifying themes; third, constructing thematic networks; fourth, describing and exploring these networks; fifth, summarizing them and finally interpreting the patterns which emerge. Braun and Clarke (2006) explains similar six phases in thematic analysis: first, becoming familiar with the data; second, generating initial codes; third, searching for themes; fourth, reviewing the themes; fifth, defining and naming the themes; and finally producing the report.

The codes, categories and themes in this study were identified both inductively and deductively. The initial analysis was made using a deductive approach with codes and themes that came from the review of the literature. Radnor notes that when analysing qualitative data that it is also possible to "not start with ready made categories within the main topics but allow them to emerge from the data as you become more and more familiar with the content" (Radnor, 2001,p.70). This is consistent with Strauss and Corbin's (1998) formulation of grounded theory where "The researcher begins with an area of study and allows the theory to emerge from the data" (p. 12). A second, inductive approach was thus also used in which the codes and themes emerged from the data.

Ezzy (2002) argues that the use of both deductive and inductive approaches to data analysis is important when conducting qualitative data analysis since these two methods are complementary and that qualitative research 'engages with the complexity of analysing human action in terms of meaning' (p.29). To addess this complexity Ezzy asserted that inductive, grounded codes help to understand and explain how these meaning and interpretations are patterned and produced.

Examples of the theoretical codes that were used are the roles of the teachers and students in the process of science curriculum reform and the phases of the reform process. The theoretical codes were also used to inform interviews designed to provide an in-depth analysis to deepen understanding. During the process of qualitative data analysis, some of the theoretical (deductive) codes that were predicted were not represented in the responses. The grounded codes that emerged from the data alerted me to new ideas that were not present in the literature and theoretical codes). Examples of these included the effects of importing a science curriculum from a Western country to an Arabic country and the relationship between science and the Islamic religion and how this influenced the learning and teaching of science.

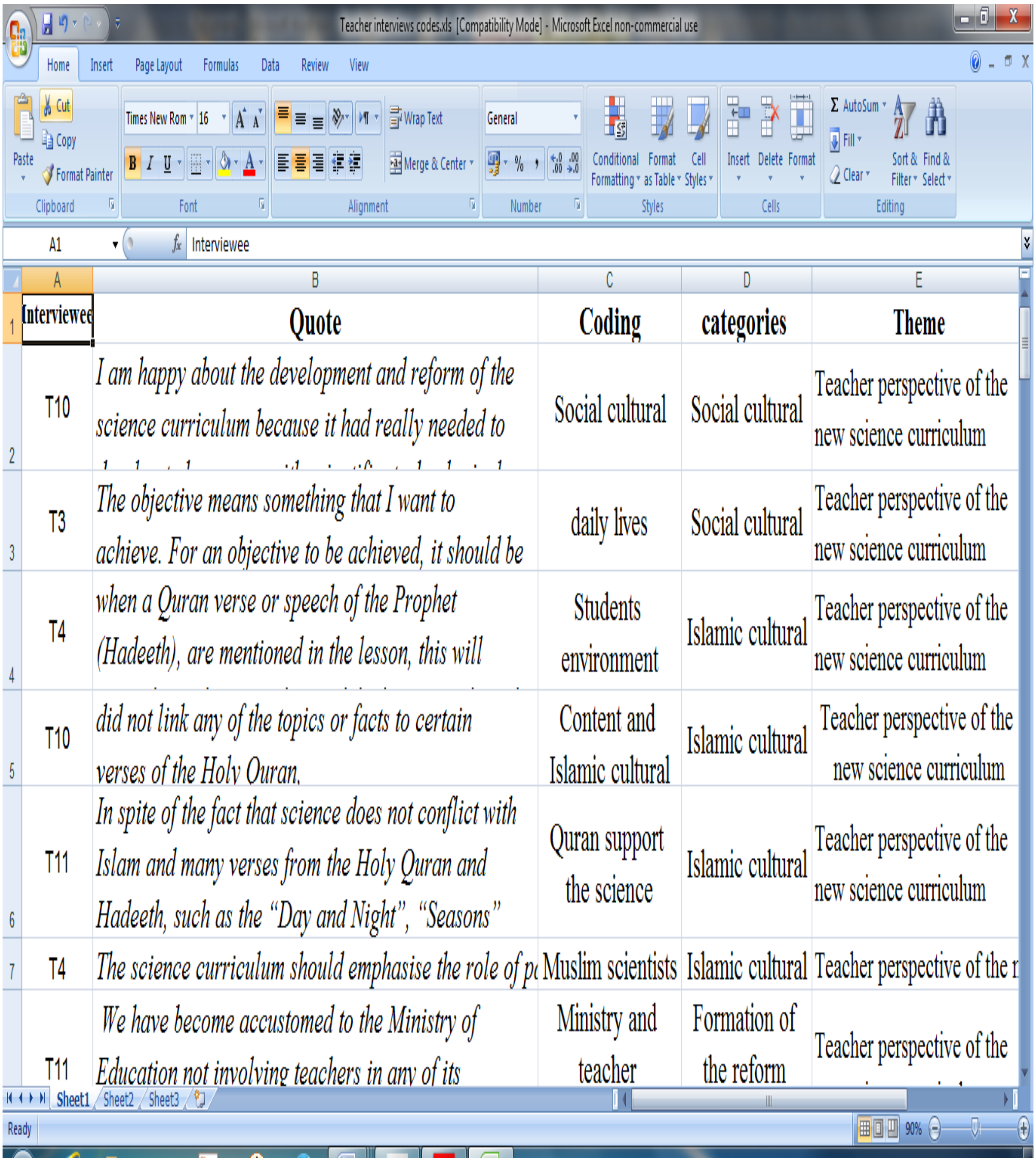
In this study, the qualitative data were analysed in six phases which correspond closely with those of Braun and Clarke (2006). All the qualitative data were collected by me and this helped me to become more familiar with them. In the **first phase** of the qualitative analysis I first created a word-by-word transcription of all the recorded interviews with teachers, students and science curriculum reformers, fieldnotes of the observations and the answers to the open-ended questionnaire questions. Each interview was carefully listened to more than once, partly to ensure that the interviews had been transcribed successfully. In addition, as noted above, after each interview the transcripts of each interview and fieldnotes of observations were sent to all the interviewees to confirm that their answers represented what the speakers meant. The interviews were transcribed in Arabic and after finishing and reviewing the transcriptions of all the interviews I translated them into English, because I preferred to analyse the data in the language of the study. This enabled me to discuss my data analysis process easily with my supervisors and my colleagues. I sent all the Arabic and English transcripts to four of the academic specialists from the English language department in Kuwait University to check the translation. All the transcripts were saved in an Excel file including all the answers to each question.

After the transcripts phase, the **second phase** was to generate the initial codes by generating an initial list of ideas about what the data contained and what was interesting about them (Braun and Clarke, 2006). The interview transcripts were carefully read many times to code the data; the code was given on the right of the transcript (see Appendix 6), which summarises the sentence or paragraph. These codes are the critical link between data collection and the explanation of their meaning (Charmaz, 2001). According to Saldana (2013), ‘‘the code in a qualitative inquiry is most often a word or short phrase that symbolically assigns a summative, salient, essence-capturing and/or evocative attribute for a portion of language-based or visual data’’ (p. 3).

In this study, I coded the data manually by writing the codes on paper with a pencil. As Saldana (2013) points out, the advantages of such a method are that it affords ‘‘more control over and ownership of the work’’ (p. 26). After I had coded all the interview transcripts, I read the transcripts and codes many times over and filtered the codes; sometimes I changed, developed or added codes, for as Saldana says (2013), coding is not a precise science and it can also change and develop; hence, the researcher needs to read the transcript with the codes carefully. Next, the information and the coded and extracted data had to be identified using a broader level of categories and themes.

After I noted the codes, the **third phase** of the qualitative analysis was to group the codes which shared similar characteristics under major categories. To identify the codes, the researcher must organise and group data and information into meaningful categories (Devetak et al., 2010). Saldana (2013) comments that similarly coded data sharing certain characteristics can be categorised as a major category, enabling the data to be organised and grouped. According to Grbich (2013), ‘‘when codes are applied and reapplied to qualitative data you are codifying a process that permits data to be segregated, grouped and re-linked in order to consolidate meaning and explanation’’ (p. 21). In this phase I used the Excel program to sort and group similar codes into categories (Figure 4.4). In addition, this Excel file was helpful for the next analytical phases and enabled me to send the file to my supervisors and colleagues to discuss the process of analysis.

In Figure (4.4), in column A is the number of the teacher being interviewed and in column B, the quotations are listed. Column C shows the code. Column D holds the categories. Column E refers to the theme. All the codes, categories and themes are presented in detail in Chapter Six.



| Interviewee | Quote | Coding | categories | Theme |
|---|---|---|---|---|
| T10 | I am happy about the development and reform of the science curriculum because it had really needed to | Social cultural | Social cultural | Teacher perspective of the new science curriculum |
| T3 | The objective means something that I want to achieve. For an objective to be achieved, it should be | daily lives | Social cultural | Teacher perspective of the new science curriculum |
| T4 | when a Quran verse or speech of the Prophet (Hadeeth), are mentioned in the lesson, this will | Students environment | Islamic cultural | Teacher perspective of the new science curriculum |
| T10 | did not link any of the topics or facts to certain verses of the Holy Quran. | Content and Islamic cultural | Islamic cultural | Teacher perspective of the new science curriculum |
| T11 | In spite of the fact that science does not conflict with Islam and many verses from the Holy Quran and Hadeeth, such as the "Day and Night", "Seasons" | Quran support the science | Islamic cultural | Teacher perspective of the new science curriculum |
| T4 | The science curriculum should emphasise the role of p | Muslim scientists | Islamic cultural | Teacher perspective of the r |
| T11 | We have become accustomed to the Ministry of Education not involving teachers in any of its | Ministry and teacher | Formation of the reform | Teacher perspective of the |

**Figure 4.4:** Example of the qualitative data inserted into the Excel file.

After grouping the codes into categories, the **fourth phase** of the qualitative analysis was to review all the categories again and compare them with each other. I then consolidated the categories which shared similar characteristics under major themes. Rossman and Rallis (2012) define a category as a word or phrase describing some segment of data, whereas a theme is a phrase or sentence presenting a more subtle description. A theme is an outcome of categorisation or analytic reflection, not something that is itself coded (Saldana, 2013, p. 14). Figure (4.5) illustrates the methods I used in relation to the codes and themes used for qualitative analysis.

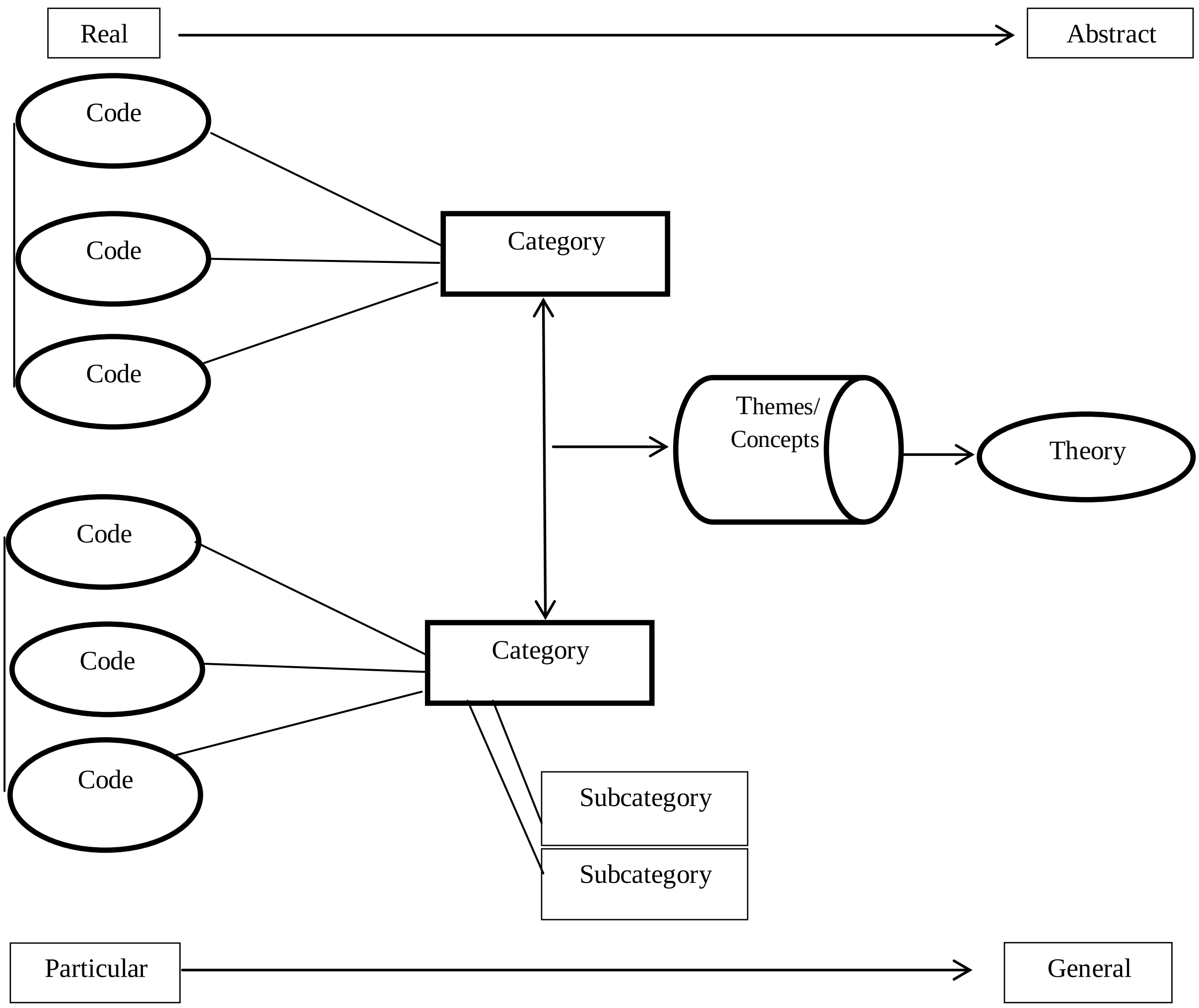



**Figure 4.5:** Streamlined codes-to-theory model for qualitative inquiry. (Adapted from Saldana, 2013).

**The fifth phase** of the qualitative analysis process was to review all the themes with their categories and codes. Then the themes were defined and named to complete the picture. Finally, **in the sixth phase,** the data were analysed according to the categories, sub-categories and themes; these are discussed in detail in Chapter Six.

The fieldnotes of the observations and the answers to the open-ended questions of the questionnaire were analysed in the same phases but these were easier because the data were simpler and less numerous than the interview data. The data from the classroom observations were also analysed manually and after each observation I transcribed the related fieldnote, concerning such things as the methods which were used in teaching the science lessons, the activities for learning which were used, the level of student participating in the learning activities, etc. These transcripts were discussed with the teacher after each observation to clarify the teacher's views about the fieldnotes and the reasons for the teaching method used in a science class. The data of the classroom observations are complementary to the questionnaire and interview data and were used to triangulate the results of the analysis of the questionnaires and interviews. Thus, the questionnaire and interview results became more meaningful when seen in light of the evidence from classroom observations. In this respect, the classroom observation data highlighted the role of the qualitative evidence from the interviews and confirmed the role of the quantitative data.

### 4.10 The trustworthiness of the study

The trustworthiness of a qualitative study is often questioned, perhaps because its concepts of validity and reliability cannot be addressed in the same way as in naturalistic work (Shenton, 2004). According to Lincoln and Guba (1985), trustworthiness consists of credibility (in preference to internal validity); transferability (in preference to external validity/generalisability); dependability (in preference to reliability) and conformability (in preference to objectivity). To assert the trustworthiness of this study, the next sections will discuss its credibility, transferability, dependability and confirmability.

#### 4.10.1 Credibility

Lincoln and Guba (1985) argue that ensuring credibility is one of the most important factors in establishing trustworthiness. Many methods have been suggested to ensure the trustworthiness and credibility of findings. These include careful attention to the study's conceptualisation and the way that the data were collected, analysed and interpreted (Lincoln and Guba, 1985). I spent more than four months in the field to collect the data from the participants and this helped me to build trust and assure the participants of the confidentiality and anonymity of my study and convince them that they would be listened to without any prejudice to their position. In addition, all the participants were informed about the study's aims and processes and were kept informed throughout the data collecting process.

To ensure the credibility of this study I used the triangulation technique (see section 4.6.4) in two ways, first through using a combination of both qualitative and quantitative data collection techniques such as questionnaires, interviews and classroom observations. Triangulation was also made possible by collecting data from different participants, such as teachers, students and reformers. The richness of the data collected by different methods and different participants provided opportunities to sort and examine them from various aspects. In addition, triangulation was used also to ensure confirmability by reducing the effect of researcher bias (Shenton, 2004).

The other technique used to ensure the credibility of this study was member-checking (Shenton, 2004). Each interview of teachers, students and reformers and observation was transcribed and then presented and checked by the participants, to confirm that their answers had been adequately represented. At the same time, member-checks were used in this study to check the interview codes. I asked three of my colleagues who have experience in interview analysis to code three interviews for the teachers, the students and the reformers to check if they gave them the same codes as I did. Their codes were nearly the same as my codes but this was helpful to discuss the codes and see whether any codes or categories might have been deleted from the transcribed data or overlooked. My supervisors also helped me in this phase.

### 4.10.2 Dependability

Dependability may be achieved through the employment of 'overlapping methods' such as the focus group, individual interview and in-depth observations. Careful methodological description allows a study to be repeated (Shenton, 2004). Shenton explains that to address the dependability issue more directly, the processes within the study such as the research design, data collection methods and their implementation should be reported to the reader in detail, thereby enabling a future researcher to repeat the work, if not necessarily to gain the same results. 'Thus, the research design may be viewed as a 'prototype model'. Such in-depth coverage also allows the reader to assess the extent to which proper research practices have been followed.' (p.71)

In this study the research design, participants' details, collecting data methods and implementation and data analysis process have been presented in detail in the text.

### 4.10.3 Transferability

The transferability is made possible by providing background data to establish the context of the study and description of a phenomenon in detail to allow comparisons to be made (Lincoln and Guba, 1985; Shenton, 2004). In this study I tried to meet the criterion of transferability by providing a rich description of the data and context through detailed descriptions of the context of the study, data collection methods and procedures, process of the data analysis, and all research participants. Moreover, quotations from the interviewees are included to make sure that the reader had access to part of the original data.

## 4.11 Ethical Issues

It was essential to attend to ethical issues from the early stages of the research, starting from process designing, through provisional decisions and the methodology. Cohen et al. (2011) assert that: 'Whatever the specific nature of their work, social researchers must take into account the effects of the research on participants and act in such a way as to preserve their dignity as human beings: responsibility to participants' (p.58). According to Bell (2010, p.39):

> *Research ethics is about being clear about the nature of the agreement you have entered into with your research subjects or contacts. This is why contracts can be a useful device. Ethical research involves getting the informed consent of those you are going to interview, question, observe or take materials from. It involves reaching agreements about the uses of this data and how its analysis will be reported and disseminated. And it is about keeping to such agreements when they have been reached.*

In the current study a Certificate of Ethical Approval from the Graduate School of Education at the University of Exeter was completed and agreed by the university before the data was collected (Appendix 10). I was careful to obtain official approval from the MoE and the Public Authority for Applied Education and Training (PAAET) and presented these to the school managers to ensure their consent (Appendices11&12). I also showed them to all participants who were to be interviewed or observed. The consent of all participants to take part in this study was initially obtained, whether in the questionnaire, interview or observation (Appendix 13). I was also keen to obtain the consent of the parents of students participating in the interview, in addition to the approval of the students themselves (Appendix 14).

All participants were assured that their personal information and names would never be mentioned at any stage of the study and they would not be asked to disclose their names. I also told all participants that all the data they presented would be kept confidential. I explained the objectives of the study to all the participants and assured them that there would be no risk in participating. To show respect for the participants I thanked them for their time and explained the importance of this study and the potential benefits which will be reflected in the development of the science curriculum and science education in Kuwait, thanks to their participation in this study. The participants' autonomy was respected and their involvement was maximised. Regarding the participants' autonomy I told all the participants that they had the right to withdraw from participation at any time and they need not answer any of the questions on which they did not wish to comment. The interviews were recorded, with the approval of the participants. All recordings have been kept in a safe place which nobody else can access. To enable the participants to feel comfortable and in control, I left it to them to schedule the time and place for interviews.

### 4.12 Summary of the chapter

In this chapter the details of the research design and the methodology have been discussed, including the details of the sample, interpretive paradigm, ontological assumptions, epistemological assumptions, methodology, methods of data collection, and process of data analysis. The quantitative and qualitative findings of the current study are presented in the next chapters (Chapters Five and Six).

# Chapter 5
# Quantitative Findings

## 5.1 Introduction

In this chapter the quantitative data which were analysed using SPSS (version 18) are presented. These data were collected using two questionnaires; one was completed by students in the sixth and seventh grades in the public schools of the State of Kuwait. The other questionnaire was completed by science teachers who teach the sixth and seventh grades in the same schools.

The aim of the students' questionnaire was to identify the students' views on the science curriculum, on science as a subject, methods of learning it and the difficulties and challenges encountered in so doing. The teachers' questionnaire explored the views of teachers about the new science curriculum. The items in this questionnaire covered the content, objectives, assessment, teaching tools, teaching methods of the new curriculum, the difficulties and challenges for the teachers in teaching it and the relationship between teachers, schools and the Ministry of Education.

The first section of this chapter presents the findings from the students' questionnaire. The second section presents the findings from the teachers' questionnaire. The main analysis of the results is based on the descriptive statistics in the form of percentages. Comparison tests such as the t-test and ANOVA tests are used to present the differences between the groups which responded to the questionnaire. The parametric statistical tests, such as the t-test and ANOVA are used to show conditions such as normal distribution, equal variances and independent samples (Corder & Foreman, 2009). Unfortunately, variables are rarely normally distributed, notably in the social sciences (Micceri, 1989). In this research the parametric statistical tests which were used depend on the Central Limit Theorem (CLT), which is one of the most important theorems in statistics. It implies that, under most distributions, whether normal or non-normal, the sampling distribution of the sample mean will approach normality as the sample size increases (Hays, 1994). The CLT confirms that if the scale of the data is ratio or interval (as in the Likert scale) and the sample is large enough and is sufficiently random, the data can be analysed parametrically without using the

normality test (Dinov et al 2008). It is confirmed in the literature (Greenberg and Webster 1983, Greene 1993, Snedecor and Cochran, 1980) that the CLT implies that parametric tests can be used when the sample size is large enough, regardless of the distribution of the sample data. Smith & Wells (2006) and Tucker & Ortiz (2007) assert that the sample being large enough is most often interpreted as meaning that parametric tests are appropriate where a dataset contains at least 30 samples, so when the Likert scale is used and the sample is large (>30) it can be assumed is that the sampling distribution of the mean is normal and the data can analysed parametrically.
In addition, Duranczyk, (2013) discusses some assumptions and the conditions which data must meet before using the CLT. The CLT assumes the following: that the randomisation condition holds (*the data must be sampled randomly)*; the independence assumption (*if we know that people or items were selected randomly we can assume that the independence assumption is met)*; and the sample size assumption: *(the sample size must be sufficiently large/ In general a sample size of 30 is considered sufficient)*. All these assumptions and conditions were met in this study: the data sample was random, the findings were independent and the sample size of teachers and students who completed the questionnaires exceeded 300.

On this basis, and informed by CLT, parametric tests are used in this study to analyse the data and three comparison tests are followed: namely the t-test, ANOVA and the Tukey multiple comparison test. However, only the statistically significant difference results of the T-Test and ANOVA are presented in the text due to the limited number of words specified for this thesis. However, all the Tukey test results appear in Appendices (15&16). The main results from both sets of answers to the questionnaire are summarised in the final section.

### 5.2 Findings from the student questionnaire

The process of analysing the questionnaire results is described in this section by first presenting details of the sample profile. Then the results of the students' responses to the questions contained in the questionnaire are presented. They concern science as a school subject, science lessons, students' reasons for learning science, learning activities, teaching tools and the student assessment system in turn.

### 5.2.1 Profile of the participants

This part of the questionnaire seeks to identify the participants` profile (their gender and grade) in order to give a clear image of and background to the participants before presenting the other results. Table (5.1) gives the participants' distribution.

**Table 5.1**

*Sample distribution according to students' gender and grade*

| Gender | | Grade | | Total |
|---|---|---|---|---|
| | | Sixth | Seventh | |
| **Boys** | Count | 195 | 215 | 410 |
| | Percentage % | 47.6 | 52.4 | 100.0 |
| **Girls** | Count | 117 | 120 | 237 |
| | Percentage % | 49.4 | 50.6 | 100.0 |
| **Total** | Count | 312 | 335 | 647 |
| | Percentage % | 48.2 | 51.8 | 100.0 |

From the table it is clear that the male students compose close to two thirds of the sample, the girls representing a little over one third. The sixth and the seventh grades are evenly balanced as regards the number of students from each in the sample.

### 5.2.2 Students' views of the science subject

Table (5.2) shows the percentage in the students' responses to science as a school subject.

**Table 5.2**

*The percentage distribution for the students' agreement with the following statements about the science subject currently taught in school*

| Items | percentage of responses % | | | |
|---|---|---|---|---|
| | SD | D | A | SA |
| 1. Science as a subject is too hard to understand | 10.2 | 10.7 | 14.4 | 64.7 |
| 2. Science as a subject is interesting | 61 | 12 | 15.5 | 11.5 |
| 3. Science as a subject is rather easy for me to learn | 62 | 15.5 | 12.8 | 9.7 |
| 4. I like science as a subject better than most other subjects | 63.9 | 15.4 | 12.0 | 8.7 |
| 5. Science helps me solve my everyday problems | 55.7 | 12.7 | 15.7 | 15.8 |
| 6. Science as a subject has encouraged me to work as a member of a team | 57.6 | 12.8 | 17.7 | 15.8 |
| 7. I would like to become a scientist | 63.5 | 9.5 | 13.5 | 13.5 |

*Notes.* Options were SA ('Strongly agree'), A ('Agree'), SD ('Strongly disagree') and D ('Disagree')

From the results in Table (5.2), it is clear that most of the students have a negative attitude about every aspect related to the subject of science. More than two thirds of the students agree or strongly agree that science is too hard to understand (# Item 1) and most of them strongly disagree with the statement that science as a subject is interesting (# Item 2). Most of the students do not believe that the science solves their everyday problems (# Item 5) and that it encourages them to work with others as a team (# Item 6).

Most students also either disagree or strongly disagree that science subject is more appealing than other subjects (# Item 4) and they will never think of becoming a scientist (# Item 7).

### 5.2.3 Students' views of science lessons

Table (5.3) shows the percentages of students' responses to the science that they learn in class.

**Table 5.3**

*The percentage distribution for the students' agreement with the following statements about the science lessons currently taught in school*

| Items | | percentage of responses % | | | |
|---|---|---|---|---|---|
| | | SD | D | A | SA |
| 8. | I understand most of the information in science lessons | 54.7 | 11.8 | 18.5 | 15 |
| 9. | I like the current science lessons | 60.9 | 12.1 | 15.7 | 11.3 |
| 10. | I like science lessons because they relate to my life | 59.3 | 16.2 | 13.1 | 11.5 |
| 11. | I don't like the current science lessons | 11.2 | 13.4 | 9.5 | 65.8 |
| 12. | The current science lessons are too hard | 8.7 | 12.1 | 11.3 | 68 |
| 13. | The science lessons are boring | 10.7 | 13.8 | 10.4 | 65.1 |
| 14. | The science lessons teach me new things | 51.6 | 10.4 | 17.1 | 21 |
| 15. | The current science lessons should be more practical | 4.7 | 5.6 | 18.1 | 71.6 |
| 16. | The current science lessons should be more technology based | 4.8 | 5.3 | 16 | 73.8 |

*Notes. Options were* SA ('Strongly agree'), A ('Agree'), SD ('Strongly disagree') and D ('Disagree')

Most of the participants either agreed or strongly agreed that they do not understand most of the current science lessons (# Item 8) and believe the current science lessons are too hard (# Item 12). Most either agreed or strongly agreed that they do not like the current science lessons (#Item 11) and believe that they are boring (# Item 13), irrelevant to their daily lives (# Item 10) and do not teach them new things (# Item 14). More than three-quarters of the students believe that the current science lessons should be more practical (# Item 15) and technology based (# Item 16).

### 5.2.4 Students' reasons for learning science

Under this topic there are some factors relating to students' objections to learning the subject of science. Table (5.4) shows the descriptive statistics of the responses to these questions.

**Table 5.4**

*The percentage distribution for the students' purpose in learning science*

| Items | percentage of responses % | | | |
|---|---|---|---|---|
| | SD | D | A | SA |
| 17. To use it in my daily life | 58.1 | 10.7 | 17 | 14.2 |
| 18. To use it to solve my problems | 60 | 11.8 | 15.3 | 12.9 |
| 19. To be a scientist in the future | 61.7 | 10.4 | 10.7 | 17.3 |
| 20. To pass the school exam | 4 | 2.3 | 10.4 | 83.3 |

*Notes.* The options were SA ('Strongly agree'), A ('Agree'), SD ('Strongly disagree') and D ('Disagree')

Through the students' responses and the results shown in the Table (5.4), it is clear that the great majority of the students study science to pass the school exam (#Item 20), and most of them would not use it in everyday life (#Item 17) or to solve everyday problems (#Item 18); nor do they wish to become a scientist in the future (#Item 19).

### 5.2.5 Students' views on learning activities used in science lessons

Under this topic there are some factors relating to the learning activities which students usually engage in to learn science in school. From Table (5.5) below, it is apparent that the most common methods of learning activities which students usually employ in the classroom to understand the science lesson are the traditional methods: taking notes from the teacher (# Item 21), reading the textbooks (# Item 22), and copying notes from the board (# Item 23). These methods have the strong agreement level of more than 50%. Most of the students strongly disagreed that they used methods associated with the internet (# Item 24), worked in groups (# Item 29), had discussion in class (# Item 26), or looked at videos (# Item 27)

**Table 5.5**

*The percentage distribution for the students' views about the learning activities which they usually use to learn science in school*

| Items | percentage of responses % | | | |
|---|---|---|---|---|
| | SD | D | A | SA |
| 21. Taking notes from teacher | 17.8 | 6.4 | 25.6 | 50.2 |
| 22. Reading the text book | 10.7 | 8.5 | 26 | 54.9 |
| 23. Copying notes from the board | 11 | 8.7 | 25.8 | 54.4 |
| 24. Researching on the internet | 60.6 | 10.2 | 13.0 | 16.1 |
| 25. Going on science trips | 53.6 | 6.5 | 12.6 | 27.1 |
| 26. Having discussions/debates in class | 55.2 | 8.5 | 15.6 | 20.7 |
| 27. Looking at videos | 54.6 | 6.8 | 16.4 | 22.3 |
| 28. Finding the answer to a scientific problem | 54.3 | 5.1 | 16.2 | 24.4 |
| 29. Working in a group/ practising cooperative learning | 56.7 | 8.2 | 15.7 | 19 |

*Notes.* The options were SA ('Strongly agree'), A ('Agree'), SD ('Strongly disagree') and D ('Disagree')

### 5.2.6 Instructional tools which are used in learning science

Under this topic are some factors relating to the students views' about the instructional tools which the teacher tends to use in the science classroom and laboratory.

**Table 5.6**

*The percentage distribution for the students' views about the instructional tools generally used by science teachers in the classroom.*

| Items | percentage of responses % | |
|---|---|---|
| | No | Yes |
| 30. Smart board | 96.8 | 3.2 |
| 31. Whiteboard | 10.4 | 89.6 |
| 32. Computer | 87 | 13 |
| 33. Pictures | 79.4 | 20.6 |
| 34. Overhead projector | 82.2 | 16.8 |

From Table (6.6) it is apparent that a high majority of the students (almost 90%) declared that science teachers generally use the whiteboard as an instructional tool to teach science and they do not generally use other education technology tools such as: computers, overhead projectors and smart boards.

### 5.2.7 Student assessment system

This part demonstrates the results of students' responses about the new student assessment system, and comprises two sections; the first shows the students' views on the assessment methods mostly favoured by the students in considering their assessment within the school *(preferred),* and the second section shows the assessment methods which are actually used by the teacher to assess the students in science *(actually used).* The comparison results of these two sections are presented in one table (5.7), for greater clarity.

**Table 5.7**

*The percentage distribution for the assessment methods which students prefer in the subject of science and the methods which are actually used by science teachers.*

| Items through which students are assessed | Status | percentage of responses % | |
|---|---|---|---|
| | | **No** | **Yes** |
| 35. Module exams | Preferred | 86.6 | 13.4 |
| | Actually used | 19.3 | 80.7 |
| 36. Practical exams | Preferred | 26.7 | 73.3 |
| | Actually used | 64.8 | 35.2 |
| 37. Oral exams | Preferred | 81.6 | 18.4 |
| | Actually used | 54.2 | 45.8 |
| 38. Course work in science classes | Preferred | 37.7 | 62.3 |
| | Actually used | 76.5 | 23.5 |

Based on the results of this section and comparison between the assessment methods preferred by students and those which are actually used by science teachers, it is clear that most of the students would prefer to be assessed through practical exams and course work in the class. However, the situation in practice is quite different from the preferences of the students: most of the students agree that they are assessed by the teacher through module test and oral examination.

### 5.2.8 Differences among different groups

This section will use the t-test to compare the results of students' responses according to students' gender (boys and girls) and students' grades (sixth and seventh).

### 5.2.8.1 The differences between groups according to gender

Table (5.8) presents the results of the differences between groups according to gender (boys and girls).

**Table 5.8**

*The t-test for two independent samples to test the views of the students according to the gender factor of the students*

| Items | Gender | Sample Size | Mean | P –value LTV [a] | t-test | df | P-value | Size Effect | Effect Type |
|---|---|---|---|---|---|---|---|---|---|
| Students' views of science as a subject | Boys | 410 | 3.49 | .000** | 4.847 | 389.0 | .000** | .057 | Small |
| | Girls | 237 | 3.06 | | | | | | |
| Students' views of science lessons | Boys | 410 | 1.63 | .000** | 4.210- | 430.1 | .000** | .040 | Small |
| | Girls | 237 | 2.02 | | | | | | |
| Students' reasons for learning science | Boys | 410 | 1.54 | .000** | 5.088- | 392.0 | .000** | .062 | Small |
| | Girls | 237 | 1.99 | | | | | | |
| Students' views on learning activities used in science lessons | Boys | 410 | 1.51 | .000** | 4.662- | 378.8 | .000** | .054 | Small |
| | Girls | 237 | 1.91 | | | | | | |

*Notes.* DF ('degree of freedom'), * The test is statistically significant at the significance level 5% ,** The test is statistically significant at the significance level 1%, a : Levene's test for equality of variance

The results of the t-test in Table 5.8 show that there were statistically significant differences between boys and girls in all the subscales at the significance level 1% (p-value <.01), the equal variances between the boys and girls populations for all of the items are not assumed since Levene's test for equality of variances was statistically significant (P-value < .01). For the sub-scales of students' views of science lessons, their reasons for learning science and views on learning activities, the differences were in favour of the girls while for the sub-scale of students' views of science as a subject, the difference was in favour of the boys at the significance level 1% (p-value <.01). The results showed that the girls hold statistically more positive attitudes than do boys to their science lessons, learning science and learning activities. This seems to contradict the finding that boys were more positive about science as a subject. This suggests that the approaches used when teaching science are more suited to girls than to boys. However, the effect sizes are small for all of the items. Statistically significant findings associated with small effect sizes are not of great practical significance but can still be theoretically important.

#### 5.2.8.1 The differences between groups according to students' grades

Table 5.9 presents the results of the differences among groups according to students' grades (sixth and seventh). From Table 5.9 it is apparent that the results of the t-tests for two independent samples according to the grade factor of the students are statistically significant at the significance level 1% (p-value <.01). For all the sub-scales (students' views of science lessons, students' reasons for learning science and students' views on learning activities) the students in the seventh grade had a more positive attitude than did the students in grade six. This result also showed that there are different views from students of different grades on these questions.

**Table 5.9**

*The t-test for two independent samples to test the views of students according to their grade*

| Items | Grade | Sample Size | Mean | t-test | df | P-value |
|---|---|---|---|---|---|---|
| Students' views of science as a subject | Sixth | 312 | 1.74 | 2.892- | 429.2 | .003** |
| | Seventh | 335 | 2.02 | | | |
| Students' views of science lessons | Sixth | 312 | 1.79 | 3.496- | 442.5 | .001** |
| | Seventh | 335 | 2.13 | | | |
| Students' reasons for learning science | Sixth | 312 | 1.67 | 2.972- | 435.3 | .003** |
| | Seventh | 335 | 1.95 | | | |
| Students' views on the teaching methods used in science lessons | Sixth | 312 | 1.83 | 3.167- | 441.1 | .002** |
| | Seventh | 335 | 2.13 | | | |

*Notes.* DF ('degree of freedom'), * The test is statistically significant at the significance level 5% ,** The test is statistically significant at the significance level 1%,

## 5.3 Teacher questionnaire findings

In this section the results of science teachers' questionnaire are presented. Initially, the results are processed by examining the questionnaire's reliability and the nature of the sample; then the results in regard to the questions contained in the questionnaire are presented.

### 5.3.1 Profile of participants

This part of the questionnaire seeks to identify the participants` profile (teaching grade, teaching old curriculum or not, gender, position, experience and nationality) in order to give a clear image in terms of the percentages of this profile before presenting the other results**.** From the Table (5.10) below, the sample consists of 310 science teachers from intermediate schools which were selected randomly. Almost half the teachers were teaching both sixth and seventh grades and most of them taught the old science curriculum. From the table it is clear that the sample is balanced between male and female teachers and most of the participants hold the rank of teacher. They have a range of teaching experience from 2 to over 20 years. From the table is it clear that most of the participating teachers have a bachelor's degree and that their specialisation is science education.

**Table 5.10**

*Sample distribution of the teachers' grade, whether they taught the old curriculum, gender, position, experience, last degree and specialisation*

| Variable | Sub-variables | Number | percentage % |
|---|---|---|---|
| Grade | Sixth Grade | 79 | 25.5 |
| | Seventh Grade | 85 | 27.4 |
| | Both | 146 | 47.1 |
| Teaching the old science curriculum | No | 52 | 16.8 |
| | Yes | 258 | 83.2 |
| Gender | Male | 168 | 54.2 |
| | Female | 142 | 45.8 |
| Position | Teacher | 271 | 87.4 |
| | Head of Department | 38 | 12.3 |
| Teaching experience | 2-5 yrs | 84 | 27.1 |
| | 6-10 yrs | 107 | 34.5 |
| | 11-15 yrs | 54 | 17.4 |
| | 16-20 yrs | 34 | 11.0 |
| | > 20 yrs | 31 | 10 |
| Last Degree Obtained | Bachelor | 299 | 96.5 |
| | Master | 10 | 3.2 |
| | Doctorate | 1 | 0.3 |
| Specialisation | Science Education | 197 | 63.5 |
| | General Science | 35 | 10.0 |
| | Physics | 19 | 6.1 |
| | Chemical | 24 | 7.7 |
| | Biology | 24 | 7.7 |
| | Geology | 11 | 3.5 |
| **Total** | | **310** | **100%** |

### 5.3.2 Teacher views about new curriculum content

This section sought to discover the science teachers' views on the content of the new science curriculum. Table (5.11) shows the percentage distribution of science teachers' views on the curriculum content.

**Table 5.11**

*The percentage distribution for science teachers' views on the content of the new science curriculum.*

| | Items | percentage of responses % | | | |
|---|---|---|---|---|---|
| | | SD | D | A | SA |
| 1. | Encourages students to contribute to society | 41.3 | 22 | 31.9 | 4.8 |
| 2. | Encourages students to work with others | 34.2 | 30.6 | 29.3 | 5.9 |
| 3. | Takes into account individual differences among students | 38.8 | 38.5 | 19.1 | 3.6 |
| 4. | Helps students to use science in their daily lives | 38.2 | 28.2 | 25.6 | 8.1 |
| 5. | Takes into consideration the society and culture of Kuwaiti students | 53.5 | 31.9 | 12.3 | 1.9 |
| 6. | The content of the new curriculum is difficult to teach | 2.6 | 12.6 | 42.6 | 42.3 |

*Notes.* The options were S A ('Strongly agree'), A ('Agree'), SD ('Strongly disagree') and D ('Disagree')

It is clear from the results about the teachers' responses in the table above that most of them have a negative view on the content of the new science curriculum. Most of the teachers agree that the content of the current science curriculum does not encourage the students to contribute to society (# Item 1), nor to work with others in a team (# Item 2). It is also noted in the results that most of the teachers agree that the content of the new science curriculum does not take into account the individual differences among students (# Item 3). Most of the teachers also agree that the content of the new curriculum is difficult to teach (# Item 6) and does not help students to use science in their daily lives (# Item 4), nor takes into account the culture of Kuwaiti society (# Item 5).

### 5.3.3 Teachers' views about the objectives of the new science curriculum

In this section, the results show teachers' views on the objectives of the new science curriculum. Table (5.12) shows the percentage distribution of these views.

Through the results in Table (5.12) it is clear that the view of most teachers about the current science curriculum objectives is negative. Almost three quarters of the teachers either disagree or strongly disagree that the new science curriculum is related to Islamic culture (# Item 7), or links the facts and scientific concepts to students' daily lives (# Item 8), or is suited to the range of the students' abilities (# Item 9), or is clearly stated and easily understood (# Item 10). More than two thirds of the teachers disagree or strongly disagree that the new science curriculum's objectives are attainable (# Item 11).

**Table 5.12**

*The percentage distribution for science teachers' views about the objectives of the new science curriculum.*

| Items | | percentage of responses % | | | |
|---|---|---|---|---|---|
| | | SD | D | A | SA |
| 7. | Related to Islamic culture | 37.7 | 35.8 | 24.8 | 1.6 |
| 8. | Linking the facts and scientific concepts to students; daily lives | 37.7 | 31.8 | 26.3 | 4.2 |
| 9. | Suited to the range of the students' abilities | 43.4 | 33.3 | 19.7 | 3.6 |
| 10. | Clearly stated and easy to understand | 46.8 | 36.7 | 14.6 | 1.9 |
| 11. | Attainable | 37.5 | 37.2 | 22.3 | 2.9 |

Notes. The options were SA ('Strongly agree'), A ('Agree'), SD ('Strongly disagree') and D ('Disagree')

### 5.3.4 Teachers' views about the student assessment system

This section sought to clarify the science teachers' views about the new student assessment system, which was applied at the time that the new science curriculum was implemented. Table (5.13) shows the percentage distribution of science teachers' views on the new student assessment system.

**Table 5.13**

*The percentage distribution for science teachers' views on the new student assessment system*

| Items | | percentage of responses % | | | |
|---|---|---|---|---|---|
| | | SD | D | A | SA |
| 12. | Takes into consideration the students' abilities | 32.4 | 38.5 | 25.6 | 3.6 |
| 13. | Gives the opportunity for teacher to use different assessment methods to assess the students | 42.3 | 27.1 | 25.2 | 5.5 |

*Notes*. The options were SA ('Strongly agree'), A ('Agree'), SD ('Strongly disagree') and D ('Disagree')

Given the results in the table above, it is clear that most of the teachers agree that the new assessment system does not take into consideration the differing abilities of students, since it does not give the opportunity for teachers to use different assessment methods in assessing them.

### 5.3.5 Teacher objectives for teaching the science curriculum

This question sought to clarify the science teachers' objectives in teaching the new science curriculum. Table (5.14) shows the percentage distribution of science teachers' objectives.

**Table 5.14**

*The percentage distribution for the science teachers' objectives in teaching the new science curriculum.*

| Items | percentage of responses % | | | |
|---|---|---|---|---|
| | SD | D | A | SA |
| 14. Help students to understand the content | 0 | 1 | 38.1 | 61 |
| 15. Prepare students for the school exam | 14.2 | 12.6 | 40.8 | 32.4 |
| 16. Achieve the curriculum objectives | 0.3 | 3.9 | 45.2 | 50.6 |

*Notes.* The options were SA ('Strongly agree'), A ('Agree'), SD ('Strongly disagree') and D ('Disagree')

It is clear there is little consensus among the teachers that their objectives in teaching the new science curriculum are to help students to understand the content (# Item 14), and to achieve the curriculum objectives (# Item 16); meanwhile, more than 70% agree or strongly agree that the teacher's objective is to prepare students for the school exam (# Item 15).

### 5.3.6 Teachers' views about the Ministry of Education support

This question seeks to explore the science teachers' views on the support that they receive from the Ministry of Education with respect to the new science curriculum, the curriculum reform process and curriculum implementation. The results of this question are shown in Table (5.15).

Based on this section's results presented below, it is clear that most of the teachers are dissatisfied with the support that they receive from the Ministry of Education with regard to the new science curriculum. Most teachers agreed that the MoE did not explain the curriculum reform process to them (# Item 17), and did not involve them in preparing the teaching plan for the new science curriculum (# Item 18). Most of them agreed that the MoE did not provide training courses relating to the new science curriculum (# Item 20) and did not help them to solve the problems relating to it (# Item 21).

**Table 5.15**

*The percentage distribution for the teachers' views on the support which they receive from the Ministry of Education related to the new science curriculum.*

| Items | percentage of responses % | | | |
|---|---|---|---|---|
| | SD | D | A | SA |
| 17. Explained to teachers the process of the curriculum reform | 41.6 | 31.3 | 22.9 | 4.2 |
| 18. Provide clear curriculum teaching plan for the new curriculum | 41.3 | 21 | 31.9 | 6.1 |
| 19. Involve teachers in preparing teaching plans for new science curriculum | 58.4 | 34.8 | 4.5 | 2.3 |
| 20. Provide training courses related to new science curriculum | 39.9 | 19.2 | 32.1 | 8.8 |
| 21. Help me to solve problems related to the new science curriculum | 41.3 | 36.8 | 20 | 1.9 |

*Notes.* The options were SA ('Strongly agree'), A ('Agree'), SD ('Strongly disagree') and D ('Disagree')

### 5.3.7 Teachers and curriculum reform process

This question seeks to explore the extent to which teachers participated in the science curriculum reform process, and experimented with the new science curriculum and attended training courses relating to it. The percentages for this result are shown in Table (5.16). From Table (5.16) below it is apparent that almost none of the teachers participated in the reform of the current science curriculum (# Item 22) and 85% did not have the opportunity to express new ideas for such reform (# Item 23). Most teachers also had no opportunity to experiment with the new science curriculum before having to implement it (# Item 24). Almost 73% of the science teachers did not attend training courses related to the current science curriculum before its implementation (# Item 25).

**Table 5.16**

*The percentage distribution for teachers' participation, preparation and training for the new science curriculum.*

| Items | percentage of responses % | |
|---|---|---|
| | No | Yes |
| 22. Participation in reforming the new science curriculum | 96.8 | 3.2 |
| 23. Having the opportunity to express new ideas for reforming the curriculum | 84.8 | 15.2 |
| 24. having the opportunity to experiment with the current science curriculum before implementation | 98.7 | 1.3 |
| 25. Attending any training courses related to the current science curriculum before its implementation | 72.8 | 27.2 |

### 5.3.8 Teachers' views about the school support

This question seeks to explore the science teachers' views on the support which they receive from their school. The result of this question is shown in Table (5.17).

**Table 5.17**

*The percentage distribution for the teachers' views about the support they receive from their school.*

| Items | percentage of responses % | | | |
|---|---|---|---|---|
| | SD | D | A | SA |
| 26. The school provides the teaching tools which I need | 28.5 | 22.3 | 39.2 | 10 |
| 27. The school provides training courses related to the new science curriculum | 45.8 | 38 | 13 | 3.2 |
| 28. The school provides suitable science labs. | 6.5 | 4.8 | 62.3 | 37.4 |
| 29. The school provides suitable classrooms | 6.8 | 23.9 | 63.5 | 15.8 |
| 30. The school provides a technology library | 22.6 | 31.6 | 32.6 | 13.2 |

*Notes*. The options were SA ('Strongly agree'), A ('Agree'), SD ('Strongly disagree') and D ('Disagree')

The results clearly indicate that most teachers are dissatisfied with the support that they receive from their school. From Table (5.17) it seems that most of the teachers disagree or strongly disagree that the school provides the teaching tools which relate to the new science curriculum (# Item 26). More than 80% of teachers strongly disagree and disagree that the school provides training courses related to the new science curriculum (# Item 27) and provides a technology library (# Item 28).

### 5.3.9 Instructional tools used to teach science

This question sought to identify the views of science teachers on the teaching tools that they generally use in the classroom. From the results in Table (5.18) below, it is clear that almost all the teachers do not use a smart board or overhead projector in the classroom to teach the new science curriculum; however, more than a quarter of them use a whiteboard and more than one third of them use computers in the classrooms to teach the new science curriculum.

**Table 5.18**

*The percentage distribution for instructional tools that the teachers use in the classroom to teach science.*

| Items | percentage of responses % | |
|---|---|---|
| | **No** | **Yes** |
| 32. Smart board | 98.1 | 1.9 |
| 33. Computer | 61.3 | 38.7 |
| 34. Overhead projector | 98.7 | 1.3 |
| 35. Whiteboard | 27.2 | 72.8 |

### 5.3.10 Teaching methods used by teachers to teach science

This question sought to identify the views of science teachers about the teaching methods that they generally use in the classroom. The result of this question is shown in Table (5.19).

**Table 5.19**

*The percentage distribution for the teaching methods that the teachers use in the classroom to teach science*

| Items | percentage of responses % | |
|---|---|---|
| | **No** | **Yes** |
| 36. Lecture | 31.9 | 68.1 |
| 37. Problem-solving learning | 91.6 | 8.4 |
| 38. Cooperative learning | 53.2 | 46.8 |
| 39. Discussion | 29.4 | 70.6 |

From the results in the above table it is apparent that two-thirds of the respondents use a lecturing method to teach and 70% use discussion to teach the new science curriculum. Less than half of them use cooperative learning, and more than 90% do not depend on the problem-solving learning method.

### 5.3.11 Challenges which face the teacher in teaching the science curriculum

This question sought to identify the views of science teachers on the teaching challenges and difficulties which affect them in teaching the science curriculum. The result of this question is shown in Table (5.20). The highest majority is in answer to the question whether teachers have to follow the Ministry teaching plan when teaching the new science curriculum and must not change it. A majority of them agree or strongly agree that the large number of students in their classes hinders their teaching and the workload has hindered them from achieving the curriculum objectives. Almost two thirds of them disagree or strongly disagree that the period of class time is appropriate for teaching the new science curriculum.

**Table 5.20**

*The percentage distribution for the science teachers views on the challenges that affect them in teaching the new science curriculum.*

| Items | percentage of responses % | | | |
|---|---|---|---|---|
| | **SD** | **D** | **A** | **SA** |
| 40. I have to follow the Ministry's teaching plan | 1.3 | 9.7 | 26.8 | 62.3 |
| 41. I can change the Ministry's teaching plan | 43.2 | 25.8 | 22.6 | 8.4 |
| 42. The large number of students in the class hinders teaching | 4.5 | 11.6 | 30.6 | 53.2 |
| 43. The workload has hindered me from achieving the curriculum objectives | 1 | 9.4 | 32.4 | 57.3 |
| 44. The length of the school academic year is appropriate for teaching the new science curriculum | 27.7 | 37.4 | 26.8 | 8.1 |
| 45. The period of class time is appropriate for teaching the new science curriculum | 31 | 33.2 | 28.1 | 7.7 |
| 46. The school assigns me extra work that is not related to my teaching | 7.4 | 14.6 | 31.1 | 47.9 |

*Notes.* The options were SA ('Strongly agree'), A ('Agree'), SD ('Strongly disagree') and D ('Disagree')

### 5.3.12 Differences among different groups

In this section the t-test and ANOVA tests are used to compare the differences between different groups of teachers in making their' responses. Due to the limited total of words allowed in the thesis, I presented only the results which were statistically different depending on different groups, such as those for: teaching the old curriculum or not, *(using a t-test),* length of experience and specialisation (*using ANOVA and Tukey tests)*. The results showed there are no statistical differences between groups if they are based on gender, grade or position.

#### 5.3.12.1 The differences among groups according to teaching the old science curriculum or not

This section presents the t-test results for two independent samples to compare the responses of teachers who had taught the old science curriculum, and those who had not.

**Table 5. 21**

*The t-test results comparing the science teachers who had taught the old science curriculum with those who had not, on teaching the new science curriculum*

| Items | Taught old curriculum? | Sample Size | Mean | t-test | df | P-value |
|---|---|---|---|---|---|---|
| **Curriculum content** | Yes | 258 | 2.08 | 5.49- | 302 | .000** |
| | No | 52 | 2.56 | | | |
| **Curriculum objectives** | Yes | 258 | 1.77 | 5.98- | 87.50 | .000** |
| | No | 52 | 2.31 | | | |
| **Students' assessment system** | Yes | 258 | 1.85 | 6.20- | 307 | .000** |
| | No | 52 | 2.59 | | | |
| **Teacher objectives** | Yes | 258 | 3.31 | 1.45- | 307 | .000** |
| | No | 52 | 3.42 | | | |
| **Ministry of Education support** | Yes | 258 | 1.91 | 4.60- | 306 | .000** |
| | No | 52 | 2.46 | | | |
| **School support** | Yes | 258 | 2.47 | 2.48- | 303 | .014* |
| | No | 52 | 2.68 | | | |
| **Challenges** | Yes | 258 | 1.98 | 5.19- | 307.0 | .000** |
| | No | 52 | 2.31 | | | |

*Notes.* DF ('degree of freedom'), * The test is statistically significant at the significance level 5% ,** The test is statistically significant at the significance level 1%, From Table (5.21) it is apparent that the t-test for two independent samples of the teachers' views about the content and objectives of the new science curriculum, students' assessment system, teacher objectives, Ministry of Education and school support and the challenges which faced the teachers when teaching the new science curriculum has statistically significant results according to whether the respondents had or had not taught the old science curriculum (the P-value of the tests is < .05). From the means of the results it is apparent that the teachers who had not taught the old curriculum were more positive about the new science curriculum than those who had taught it.

### 5.3.12.2 The differences among groups according to teacher specialisation

This section will present the ANOVA test result for comparing the difference in the Items related to teaching new science curriculum with the difference in the academic specialism of the teachers.

**Table 5.22 (continued)**

*The F-test (ANOVA) result for the comparing the difference of the* sub-scales *related to teaching the new science curriculum with the difference of the academic specialism of the teachers*

| sub-scales | Source | Sum of Squares | df | Mean Square | F | Sig |
|---|---|---|---|---|---|---|
| **Curriculum content** | Between groups | 30.629 | 5 | 6.126 | 23.718** | .000 |
| | Within groups | 75.933 | 294 | .258 | | |
| | Total | 106.562 | 299 | | | |
| **Curriculum objectives** | Between groups | 39.381 | 5 | 7.876 | 19.907** | .000 |
| | Within groups | 117.114 | 296 | .396 | | |
| | Total | 156.494 | 301 | | | |
| **Student assessment system** | Between groups | 51.817 | 5 | 10.363 | 19.415** | .000 |
| | Within groups | 160.138 | 300 | .534 | | |
| | Total | 211.955 | 305 | | | |
| **Teacher objectives** | Between groups | .800 | 5 | .160 | .627 | .679 |
| | Within groups | 76.305 | 299 | .255 | | |
| | Total | 77.105 | 304 | | | |
| **Ministry of Education support** | Between groups | 43.596 | 5 | 8.719 | 16.880** | .000 |
| | Within groups | 154.441 | 299 | .517 | | |
| | Total | 198.037 | 304 | | | |

**Table 5.22 (continued)**

*The F-test (ANOVA) result for the comparing the difference of the sub-scales related to teaching the new science curriculum with the difference of the academic specialism of the teachers.*

| sub-scales | Source | Sum of Squares | df | Mean Square | F | Sig |
|---|---|---|---|---|---|---|
| **School support** | Between groups | 15.198 | 5 | 3.040 | 13.200** | .000 |
| | Within groups | 67.927 | 295 | .230 | | |
| | Total | 83.125 | 300 | | | |
| **Challenges** | Between groups | 5.217 | 5 | 1.043 | 8.665** | .000 |
| | Within groups | 36.001 | 299 | .120 | | |
| | Total | 41.218 | 304 | | | |

*Notes.* DF ('degree of freedom'), **The test is statistically significant at significant level 1%

Table (5.22) shows that the ANOVA test results indicate a statistically significant difference for most of the sub-scales (content and objectives of the new science curriculum, students' assessment system, Ministry of Education and school support, and curricular challenges). The use of Tukey tests (see Appendix 16) makes it clear that the science teachers who specialised in Biology, Chemistry, Physics and Geology had more positive views about all the subscales than had the science teachers who had studied General Science.

### 5.3.12.3 The differences among groups according to teacher experience

This section presents the ANOVA test comparing the difference in the items related to teaching the new science curriculum with the differences in the teachers' years of experience.

Table (5.23) shows that the ANOVA test results indicate a statistically significant difference for all items (content and objectives of the new science curriculum, students' assessment system, Ministry of Education and School support, and the challenges) except the Teacher Objectives. When the Tukey tests were used (see Appendix 15), the results showed that the science teachers with new experience (2-5 years), and teachers with many years of experience (>20 years) had more positive views than those who have 6-20 years' experience on all items.

**Table 5.23**

*The F-test (ANOVA) result of comparing the difference of the* sub-scales *related to teaching new science curriculum with the difference of the teaching experience of the teachers*

| sub-scales | Source | Sum of Squares | df | Mean Square | F | Sig |
|---|---|---|---|---|---|---|
| **Curriculum contents** | Between groups | 12.310 | 4 | 3.078 | 9.543** | .000 |
| | Within groups | 96.429 | 299 | .323 | | |
| | Total | 108.739 | 303 | | | |
| **Curriculum objectives** | Between groups | 12.285 | 4 | 3.071 | 6.380** | .000 |
| | Within groups | 144.910 | 301 | .481 | | |
| | Total | 157.195 | 305 | | | |
| **Student assessment system** | Between groups | 15.858 | 4 | 3.965 | 6.122** | .000 |
| | Within groups | 196.880 | 304 | .648 | | |
| | Total | 212.738 | 308 | | | |
| **Teacher objectives** | Between groups | 1.499 | 4 | .375 | 1.494 | .204 |
| | Within groups | 76.256 | 304 | .251 | | |
| | Total | 77.755 | 308 | | | |
| **Ministry of Education support** | Between groups | 15.142 | 4 | 3.786 | 6.220** | .000 |
| | Within groups | 184.414 | 303 | .609 | | |
| | Total | 199.557 | 307 | | | |
| **School support** | Between groups | 3.222 | 4 | .806 | 2.968* | .020 |
| | Within groups | 81.434 | 300 | .271 | | |
| | Total | 84.657 | 304 | | | |
| **Challenges** | Between groups | 2.339 | 4 | .585 | 4.561** | .001 |
| | Within groups | 38.984 | 304 | .128 | | |
| | Total | 41.323 | 308 | | | |

*Notes*. DF ('degree of freedom'), The test is statistically significant at the significant level 1%, * The test is statistically significant at the significant level 5%

## 5.4 Summary of the chapter

Based on these analyses of the results of gathering quantitative data from the student and teacher questionnaires, it is clear that the students and teachers have a negative attitude to the new science curriculum; ways to account for these views were explored in depth in the interviews with teachers and students and in the classroom observations.

The results show that most of the students felt that it was difficult to study science, that science lessons were boring and that science subjects are not favourably considered. They feel that science is irrelevant to their daily lives and not helping them to solve the problems they face every day. The questions put to the students' focus group which are presented in the next chapter will explain in more depth the above results.

By comparing the results for boys and girls and students' grades, it was found that the girls and the sixth grade students' views on learning science as a school subject and on science lessons are more positive than the views of the boys and the students in the seventh grade.

As regards the science learning activities which students in class like to engage in, it was found that most of the students employ traditional methods to study science such as textbooks and taking notes from the board, and that most of them agreed that the reason for their studying science was to pass the school examination. By comparing these results for boys and girls and students' grades, it was found that the girls and the sixth grade students, more than any other groups, aim to study science in order to pass the examination.

With regard to the teachers' results, these indicate that the teachers agree with the students in thinking that the new science curriculum is difficult. Most of the teachers agree that the content and objectives of the new curriculum have some disadvantages, such as a lack of relevance to Kuwaiti society and a disregard of the differing abilities of the students. To explain these teachers' views, semi-structured interviews were used in this study to discover in more depth what had led to them. The results of the teachers' semi-structured interviews are presented in the next chapter.

Moreover, the results illustrate that most of the teachers did not favour the new system of assessing students. Most of them believe that this form of assessment does not help the teacher to use different methods to assess the students flexibly.

The results reveal the teachers' dissatisfaction with the support of both the Ministry of Education and their own schools. The results also indicate that most of the teachers did not participate in the reform and development of the science curriculum and that there has been a failure to provide training courses on teaching the new science curriculum. Most of the teachers did not have any opportunity to review the new curriculum before having to implement it in school.

Likewise, the results show that most of the teachers agree that there are some difficulties and challenges that affect their teaching of the new science curriculum. Among these difficulties are the workload assigned to the teacher, the large number of students in the classroom, an unsuitably short school year and insufficient class time in each teaching period to accommodate the new science curriculum. The challenges which faced the teachers in teaching science and the suggestions for meeting them and developing science education are explained in depth by the semi-structured interviews with teachers, the results of which are presented in the next chapter.

The results show that there are differences between the answers of a group of teachers based on whether or not they had taught the old curriculum, their nationality, the length of their experience and their specialism. The results indicate that, in general, non-Kuwaiti teachers, those who have not taught the old curriculum, teachers who specialised in Biology, Chemistry. Physics and Geology, and those who had both short (2-5 years) and long (>20 years) experience as a teacher, have mostly positive views on the new curriculum.

Regarding these quantitative results from the students' and teachers' questionnaires, it becomes obvious that a number of issues are worthy of further attention and clarification and that the quantitative findings should be discussed in detail. This is what the next chapter will do: in this, the results of the qualitative data from interviews with students, teachers, and curriculum reformers, and of classroom observations, will be presented to further clarify the results of the questionnaire and also to obtain additional and more in-depth information. This will include but not be limited to, an exploration of the curriculum reform process, students' and teachers' roles during the reform and implementation of the science curriculum ,students' and teachers' views about the cultural issues related to science, and the views of students and teachers on the new science curriculum. As stated in the introduction to this chapter, the results of the interviews and questionnaire are interwoven together to answer the questions and fulfil the aims of the study.

# Chapter 6

# Qualitative Findings

## 6.1 Introduction

In this chapter I discuss the qualitative data collected from the interviews with a group of 11 science teachers; from observations in intermediate schools; and from a total of 30 students in grades six and seven; together with nine interviewed out of a group of 14 curriculum reformers who helped to reform and develop the science curriculum in the State of Kuwait.

The qualitative data are complementary to the quantitative data which were collected by questionnaires. The aim of the former data is to explore in depth the views among teachers and students on the advantages, disadvantages, characteristics, strengths and weaknesses of the new science curriculum, the difficulties that face teachers and students in teaching and learning from it and the proposals for its development and reform. From examination of the qualitative data I also aim to discover the process of the curriculum reform and the implementation of the new science curriculum, the reasons for reform, the steps undertaken and the persons responsible, to form an overall comprehensive image of the reform process and its implementation.

The results of both the quantitative survey and the qualitative interviews will help to answer the following research questions:

1. What were the factors that guided and influenced the science curriculum reform process in grades six and seven of the intermediate stage?
2. What were the phases of the science curriculum reform process in these grades?
3. What are the teachers’ views on the new science curriculum in these grades?
4. What are the students’ views on this new science curriculum?

The data were analysed qualitatively under the themes, categories and sub-categories which guided the data collection. Some themes were there before the analysis (a priori), and other themes emerged from analysis of the data (were emergent) (Table 6.1). In this analysis four themes were found: the factors from which the curriculum reform was derived; the phases of the reform process, the teachers' views on the new science curriculum and students' views on the new science curriculum.

**Table 6.1**: Shows the themes, categories and sub-categories related to the research questions which are answered by reference to them

| Themes | Categories | Research questions which were answered |
|---|---|---|
| 1. Factors that guided and influenced the science curriculum reform process. | 1. Outdated curriculum.<br>2. Globalisation.<br>3. International comparisons tests.<br>4. Social and cultural factors<br>5. Develop the science education in Kuwait.<br>6. Develop students' learning skills and abilities. | 1. What are the factors that guided and influenced the science curriculum reform process in the intermediate stage (grades six and seven)? |
| 2. Phases of the curriculum reform process | 1. Formation of the reform panel.<br>1.1 Assistant under-secretary's role.<br>1.2 Science education inspector role.<br>1.3 MoE staff role.<br>1.4 Science teacher and student participation.<br>2. Curriculum selection<br>2.1 Selection of a curriculum already for teaching.<br>2.2 Western curriculum<br>3. Curriculum adaptation<br>3.1 The nature of the adaptation process.<br>3.2 Factor influencing the adaptation process.<br>4. Curriculum implementation<br>4.1Implementation process<br>4.2 Teachers and new curriculum implementation<br>4.3 Students and new curriculum implementation<br>5. Challenges of the curriculum reform process.<br>5.1 Centralism<br>5.2 The limited time<br>5.3 Finance support<br>5.4 Adaptation standard | 2. What are the phases of the science curriculum reform process in the intermediate stage (grades six and seven)? |
| 3. Science teachers' views on the new science curriculum | 1. Social cultural<br>1. Islamic cultural<br>2. Students' abilities<br>3. Teaching methods<br>4. Student assessment<br>5. Challenges<br>6. Teachers' recommendations | 3. What are the teachers' views on the new science curriculum in these grades? |
| 4. Students' views on the new science curriculum | 1. Attitudes to learning science<br>2. Science content<br>3. Effective ways of learning<br>4. Modes of assessment<br>5. Students' recommendations | 4. What are the students' views on the new science curriculum in these grades? |

## 6.2 Factors that guided and influenced the science curriculum reform process

This theme is responding to the research question: *What are the factors that guided and influenced the science curriculum reform process in the intermediate stage (grades six and seven)?* Six categories were constructed under this theme, namely, the previous curriculum being out of date, globalisation, international comparisons, social and cultural factors, the need to develop science teaching in Kuwait, and the need to develop students' learning skills. These categories are discussed below.

### 6.2.1 Outdated Curriculum

Six of the reformers who were interviewed indicated that the old science curriculum was out of date and needed to be developed. They agreed that the science subjects specifically are in a state of constant development, because scientists make new discoveries and the science curriculum must be updated to include these. They are referred to here by number (R1, R2 etc.).

*The studies conducted have established that the old science curriculum was no longer consistent with scientific developments (R4).*

These six reformers also remarked that the purpose of the curriculum reform was to keep up with global changes and developments in the scientific, technological, economic and social fields. *We aim at bringing the science curriculum into line with modern developments (R1).*

### 6.2.2 Globalisation

Four of the reformers interviewed highlighted that globalisation was one of the factors taken into account when reforming the science curriculum; they believed that Kuwait, as part of the modern world, must keep up with overall changes. One of the reformers said:

*As we live in a rapidly changing world and Kuwait is part of this world, many changes have appeared in our lives to which the curricula must be aligned, especially the science curriculum (R 9).*

They agreed that the purpose of the science curriculum reform was to keep up with world changes and developments in the scientific, technological, economic and social fields. *We maintain that... one of the goals of the reform was to make a new* *curriculum that could cope with technological, economic and even social developments all over the world (R6).*

### 6.2.3 International comparison tests

All the reformers who were interviewed believed that the low results of Kuwaiti students in the TIMSS test was one of the factors that prompted and guided the reform process of the science curriculum since it was deemed urgent to address the weakness of Kuwaiti students. One of the reformers explained how this low result had set the reform in motion:

*The TIMSS test, which demonstrated that the Kuwaiti students were weak in thinking skills and in learning science, was one of our references in reforming the science curriculum and we took it into account in our actions, We chose a new curriculum to develop the students' abilities and skills in thinking and learning about science (R2).*

In addition to the TIMSS test results, all the reformers who were interviewed agreed that the local and international scientific studies dealing with the development and reform of the curricula were among the sources on which the curriculum reform process was based.

*We were keen to review the latest and most important and theories, scientific studies and recommendations in the field of curricular development and held meetings with academic specialists from Kuwait University on this matter (R3).*

They stated that the experiences of some countries which have developed their curricula, were examined for the lessons that they held.

*In addition, we considered the experiences of other countries in connection with the reform and development of the curriculum, such as the USA, UK, Singapore and some Arab countries such as Lebanon and Saudi Arabia. We made use of the experiences of other countries so as to know the pros and cons of their experiments in the process of curriculum reform (R5).*

### 6.2.4 Social and cultural factors

All the reformers who were interviewed indicated that among the important factors in guiding the reform process were the culture, traditions and nature of Kuwaiti society.

*The important point to take into account in the… process was to relate the new science curriculum to the Arab and Muslim culture which characterises the Kuwait society (R5).*

The reformers mentioned that they did their best to link the new science curriculum as closely as possible to the culture of Kuwait society, Islamic religion, social need, and students' daily lives and environment. Moreover, they stated that it was their concern to introduce a new curriculum that would contribute to students' expertise in science for solving the problems of daily life. Three of these reformers spoke of the importance of relating the science curriculum to the culture of Kuwait and they agreed that this would help students to understand the content of the curriculum. One of these reformers said:

*We were very careful to select the science curriculum which related to the culture of Kuwaiti society because, from my experience in teaching science, doing so would help the students to understand the curriculum content more easily. Many studies confirm this point (R9).*

When I asked the reformers about how they made sure that the new science curriculum was related to the culture of Kuwait, they replied as follows:

*Through the process of adaptation and review we have been keen to make the examples, lessons and even pictures close to the student's nature and daily life. However, as you know, it is not possible to connect all the topics in the science course to the student's experience. The course may contain some scientific topics that we cannot give examples of from our environment, such as Arctic and other climatic conditions and snow in winter. In Kuwait and most Arab countries, snow is rare. The local environment provides no examples of it (R2).*

And for the Islamic religion, reformer (3) said:

*We changed any pictures and examples which were in conflict with Islamic religious beliefs and after this the content (from my view) was suitable and did not conflict with Islam.*

### 6.2.5 Develop the science education in Kuwait

All the reformers who were interviewed agreed that the main aim of the process was: *to develop the science teaching in the Kuwait, as well as the development of science education in general (R1).*

To explain how the new science curriculum would help to develop the teaching of science, one of the reformers (R2) said:

*Where the old curriculum was based on memorising and reproducing, the new one keeps pace with the latest developments of modern science, being based on helping students to use the skills of self-learning and encouraging them to research, explore and access results for themselves. Hence this will improve and develop the way that science is taught here.*

Six of the reformers agreed with the view of reformer R2 quoted above, but one said:

*I agree that the aim of the science curriculum reform process is to develop the teaching of science and science education generally in this country. We did our best to select the curriculum which could fulfil this aim but in my view it is too early to judge whether the new curriculum has done so. More studies are needed to evaluate this (R4).*

### 6.2.6 Develop students' learning skills and abilities

From the point of view of the reformers, one of the factors that influenced the curriculum reform process was the ability of the students concerned. Seven of the reformers maintained that they took care to see that the curriculum content, objectives, explanations and techniques would be *suitable to the Kuwaiti students' abilities (R4).*

Another one added: *Using our experience and familiarity with scientific studies in connection with the nature and capabilities of [our] students, we did our best to select a new curriculum which would help to develop the students' abilities and scientific skills. Those skills which the Kuwaiti students lack, such as critical thinking, problem-solving and inference were featured and focused on (R5).*

Another of the reformers (R1) said:

*The new science curriculum content is explained simply, so as to suit our students' abilities and in my view it will improve their abilities, but we will need to evaluate it after a while (R1).*

The above six subheadings outline an answer to the first research question, *What are the factors that guided and influenced the science curriculum reform process in the intermediate stage (grades six and seven)?* The findings under these subheadings show that certain factors guided, influenced and were taken into account in the process of reform. Having listed these factors, I now explore the phases of the reform process itself.

### 6.3 Phases of the science curriculum reform process

After discussing their views on the factors which guided and influenced the process of reforming the science curriculum, the reformers spoke of four phases in the process, namely, forming the reform panel; selecting the new series of curricula; adapting it; and implementing it in the schools. These will be discussed in turn. The data was collected to answer the research question: *What are the phases of the science curriculum reform process in the intermediate stage (grades six and seven)?* Five subheadings were constructed for the categories illustrating this theme, namely, the formation of the reform panel, curriculum selection, curriculum adaptation, curriculum implementation, and the challenges of the reform process. These categories are presented below.

#### 6.3.1 Phase one: Formation of the reform panel

All the reformers confirmed that the process of curricular reform was undertaken by a committee headed and convened by the Assistant Undersecretary for the Curricula Sector at the MoE in Kuwait. Its members were a group of the Education Inspectors for science and some staff from the Ministry of Education, a total panel of 14, of which I interviewed nine (seven science inspectors and two staff).

None of the members could say why they had been chosen but they knew that the assistant undersecretary had made the choice. One of reformers guessed that he had been *designated… perhaps because of  the number of years' experience.*

He added*: I am not sure why and I have not asked (R5).*

To describe the role of this committee and the duties of its members, I searched the interview data**.**

#### 6.3.1.1 Assistant undersecretary role

All the reformers knew that the reform was led and supervised by the Assistant Undersecretary for Curricula, whose role in this project was to chair the meetings, discuss ideas with the reformers and search for solutions to the problems which they faced.

All the reformers agreed that decisions, such as choosing the curriculum series, deciding on the adaptations and the way to implement the new curriculum, were in the hands of the Assistant Undersecretary. She took *the final decision (R7).*

All the reformers also agreed on the importance of the chairwoman's role but three of them disagreed about the responsibility for the final decision in the reform process, which they think should have lain with the whole committee. *The final decision is made by the Undersecretary for their own reasons, but I disagree… I think the final decision should be taken by the whole reform committee (R5).*

#### 6.3.1.2 Science education inspector role

The reformers also stated that most of the members of the 14-strong reform committee (10 for grade 6 reform and 14 for grade 7) were Education Inspectors in science. Seven of them were interviewed in the present research. They stated, *not all the Education Inspectors in Kuwait were asked by the Assistant Undersecretary to participate in the reform process (R2).*

The Education Inspectors confirmed that their role was advisory in all the phases of the reform. They discussed their views with the whole committee before the Assistant Undersecretary made her decision.

*Our role is advisory because we are working to select the new curriculum series, and then we adapted it and sent the final version to the Assistant Undersecretary for the final decision, (R3).*

#### 6.3.1.3 Ministry of Education staff role

All the reformers stated that three staff who were working in the curriculum sector in the Ministry of Education participated in the science curriculum reform process (two of them were interviewed in this research). All of the reformers confirm that the role of the MoE staff was advisory, *in all the reform phases, selection, adaptation and implementation (R7)*, like that of the science Inspectors.

#### 6.3.1.4 Science teachers' and students participation

All the reformers confirm that teachers and students did not participate in any way at any stage of the curriculum reform process and were not offered the chance to share in it. The reformers indicate several reasons for the non-participation of teachers and students or the fact that they were not invited to collaborate in the reform. Two of the reformers said that teachers and students do not have *experience enough to make them able to contribute in the curriculum reform (R2).*

Another point made by three reformers is that the reason teachers and students were not called in was for pressure of time. These three were aware of the importance of participation by teachers and students, but claimed that the opinions of teachers and students could not be sought because *within a year, we had to select and adapt the curriculum.* [It was a] *great deal of work in a short time…We did not have enough time to call in teachers or students (R1)*.

Two of the reformers added to the shortage of time the pressure of work on the teachers which was enough to exclude them from taking part.

The Education Inspectors said that the teachers already had their work and that their participation in the curriculum reform would have delayed their delivery of the content to the classes. Therefore, these reformers thought that it would be better not to involve the teachers but let them spend their time in teaching.

*Teachers have many duties that must be conducted, so that I believe that if the teachers were to participate in the curriculum reform, this would create delays in their teaching of the students (R6).*

Four of the reformers stated that the non-participation of the teachers and students in the process of curriculum reform had been a great mistake on the part of the MoE. These reformers assert that they had asked in more than one meeting with the Assistant Undersecretary that teachers and students be involved in the curriculum reform *at least in the adaptation phase* and their views listened to, but they received no response.

This finding was emphasised by the teachers and students in their interviews. I interviewed 11 teachers, and six groups of five students; a total of 30 students. They all confirmed that they had never taken part in any stage of the reform, but instead had heard only through the media that the MoE was reforming the curriculum. Not only had none of the teachers interviewed been involved in the reform process nor *met any teacher or student who ... had been involved* in it, but they were surprised to find a new curriculum at the beginning of the school year, which they were asked to teach. *We have become accustomed to the Ministry of Education not involving teachers in any of its decisions,* was the comment of one (T11).

Although none of the science teachers interviewed took part in the reform all of them agreed on the importance of the science curriculum reform process for all the grades of compulsory education in Kuwait. These teachers confirmed that the previous science curriculum had been in need of reform and development because it had not kept pace with scientific and technological developments in the world, did not meet the needs of society and did not contribute to the development of students' skills in research and intellectual exploration.

*I am happy about the development and reform of the science curriculum because it had really needed to develop to keep pace with scientific, technological and social developments (T10).*

Of all the students who were interviewed, none had been consulted in changing the curriculum. One said, *I did not participate in the curriculum reform and don't know who changed the curriculum or why (S3)* while another commented *I don't know anything about the new science curriculum selection and how, by whom, when and why this curriculum was selected (S3).*

Three teachers suggested some ways of involving them in the reform: *through a questionnaire, or ... a website where a teacher can ... write his comments and suggestions for developing the curriculum (T9).* These suggestions, of course, both meet the problems of time constraints.

Nine of the teachers concurred that their non-participation in and lack of information about the new curriculum before it was imposed on the schools made *the teacher feel difficulty with the curriculum and this is reflected on the students, as well (T10).* Its potential adverse effect on the teacher's performance impacts on the students' understanding of the content, which results in a feeling common to teachers and students that the new curriculum is difficult.

### 6.3.2 Phase two: Curriculum selection

After the reform panel was formed the next phase in the science curriculum reform process was to select the new science curriculum series, included the curriculum content, objectives, teaching guide, textbook and teaching tools as described by the reformers who were interviewed. As they confirmed, the Assistant Undersecretary for the Curriculum Sector formed a committee whose mission was to select a series of new science curricula. All reformers who were interviewed confirmed that after several meetings, they decided to be independent of the Gulf Cooperation Council's (GCC) unified science curriculum. During their interviews I noticed that they all supported this decision, giving as reasons that it would *give us the freedom to reform and develop the science curriculum in the future, [since reforms] in the past [needed] the agreement of all members of GCC and this hindered the process (R1).*

With their agreed purpose (see above), all the reformers indicated in their interviews the elements to be reformed, consisting of *the science curriculum content, science curriculum objectives, students' assessment system, teaching plan and instructional tools (R4).*

All the reformers interviewed indicated that both the teaching plan of the new science curriculum and the students' assessment system were to be designed for the reform by the reformers in Kuwait's MoE in Kuwait, while the remaining elements – the science curriculum content, objectives, textbooks and teaching tools – were designed in the USA.

*We selected the new science curriculum from the Scott Forestman company, together with its objectives, content, textbook and its teaching tools and adapted it to suit the culture of our students, while we designed the teaching plan of the new science curriculum and students' assessment system in the MoE in Kuwait (R1).*

**6.3.2.1 Selection of a curriculum ready for teaching**

All the reformers stated that the official reason for deciding on *a new curriculum that was already being taught, instead of producing a new curriculum, [was] to save time and effort, as some officials stated (R4).*

It would need only to be adapted to make it suitable for Kuwait's social and cultural needs.

Unlike the majority, three reformers would have preferred to design a new science curriculum for Kuwait. The reasons for this preference were that it would have helped to ensure a successful reform process because it would have produced a science curriculum more suitable than the one that had to be adapted, since the designers would have been familiar with the local situation and the strengths and weaknesses of Kuwaiti students, although one of the reformers claimed *I presented this idea to all the reformers, ...most of them agreed to select a curriculum already in use (R9).*

Another reformer (R3) observed:

*Each method has advantages and disadvantages but the important thing is how to review and adapt this curriculum and subject it to stringent testing and scrutiny by more than a single person or one authority until it matures into the appropriate form. Saving time may have been the major reason… for introducing a curriculum already in use.*

After making this decision, they first looked at the experiences of some neighbouring Arab countries which had recently tackled curriculum reform, such as Lebanon, the Kingdom of Saudi Arabia and the UAE. The reformers confirmed that they wanted *a new curriculum that had been translated into Arabic* and found two which complied.

They chose a curriculum used in countries which had the *same social cultural features as Kuwait (R1)* and had been tested in the schools of these countries. The reformers stated that, having reviewed the experiences of some Arab states in the relevant field, they found two science curricula series which had recently begun to be taught in Lebanon and the Kingdom of Saudi Arabia. Lebanon was now using the science curriculum series published by Scott Forestman and translated into Arabic by a Lebanese education research centre and Saudi Arabia was using another which had been published by McGraw-Hill, translated to Arabic and adapted for use with Saudi students by the local Al-Obeikan company. The reasons for the selection of these curriculum series, according to the reformers, are given below.

After finding these two companies, Kuwaiti officials made contact with them to ascertain their offers and choose between them. They held several meetings to evaluate the companies' offers and it was agreed at first to pick the McGraw-Hill curriculum taught in Saudi Arabia. Finally, however, they settled on the other. The reason for doing so, as most reformers agreed, was that it was appropriate for the reform and the educational aims of the committee. But one of the reformers (R6) mentioned a different reason: *I would like to say frankly – this information has not been revealed by the officials - the reason for our rejecting the McGraw-Hill curriculum series and opting for the other was the price. We tried to get a discount but we couldn't manage it. If you ask anyone else, I am sure, unfortunately, that nobody will tell you that the price was the main reason for the choice. Some of the reformers preferred the McGraw-Hill curriculum but the final decision was taken by the Assistant Undersecretary and some reformers agreed with it.*

The selection of the Scott Forestman company took account of the *curriculum aims, science textbook and the curriculum teaching tools (R1)*; this is confirmed by all the reformers who were interviewed. The reformers' views about choosing a Western science curriculum to be taught in Kuwaiti schools are further discussed under the next subheading.

#### 6.3.2.2 Western curriculum

It was new to Kuwaiti education to choose a science curriculum which had been designed in the West. Seven of the reformers who were interviewed approved of doing so because they believed that the science curriculum and education in Western countries were better than in Arab countries and that teaching a Western curriculum in Kuwait would develop the science education and students' abilities. In this regard, reformer R6 mentioned that *the latest TIMSS test results*, together with his teaching experience had convinced him that science education in the West was better. Thus he *strongly agreed* with having a Western science curriculum taught in Kuwait. However, some of the reformers had different reasons for selecting a Western science curriculum, such as one cited by reformer (R8): that very few *Arab publishing companies were designing a science curriculum* and *there [was] no publishing company in Kuwait. But there [were] many Western companies* to choose from.

Reformer (R3) mentioned another reason for this choice:

*We did not decide to pick either a Western or an Arab science curriculum in advance, but after reviewing many science curriculum series from many companies we selected the one that we did because we found it was the best curriculum series which would achieve the aims of reform.*

Although six of reformers agreed to use a Western science curriculum in Kuwait, three of them took a different line. These reformers argued that the socio-cultural, religious and customary conditions in Western countries are different from those in Kuwait, and the science curriculum had to relate to what the students were familiar with. Hence, they thought that a Western curriculum would not succeed in Kuwait unless a thorough revision and full adaptation could make it suitable. Interviewee R2 said *that he discussed [this] view with all the reformers and the Assistant Undersecretary but almost all of them disagreed.*

Reformer R4 also differed and hoped that the present study would examine the position:

*I do not find any problem with the use of curricula that are designed in Western countries so long as they are carefully revised and adapted to suit our students. The current science curriculum needs some research to check whether it has been well adapted or not…*

All the reformers agreed that the curriculum series published by Scott Forestman needed adapting to suit the Kuwaiti society and its cultural, environmental and religious features. The curriculum adaptation was the next of the curriculum reform phases and is discussed in more detail below.

### 6.3.3 Phase three: Curriculum adaptation

All the reformers knew that the next step was for the Assistant Undersecretary to form an Adaptation Committee. They told me that this committee had the same membership as the selection committee. The science teachers and students did not have any role in this phase either (see section 6.3.1.4**)** and none of them knew any details of what had gone on in it.

All the reformers who were interviewed stated that the aim of the committee was to revise and adapt their chosen curriculum to suit the culture, traditions, needs, abilities, Islamic norms and environmental conditions of Kuwaiti students

*The purpose of the new science curriculum adaptation process is adapting it to be relating to the Arab Islamic culture, culture of Kuwait society, Kuwait traditions, social need and students' abilities (R6).*

The new curriculum, designed in the USA, naturally needed adaptation before it was implemented as all the reformers who were interviewed agreed. They said, moreover, that the adaptation process was a major phase in the reform process because of the great need to relate it to Kuwaiti students. On this point reformer R5 mentioned that it would have to *relate to the students' everyday lives. [Its] pictures, content, explanations, words and examples,* for example, *would need revision and amendment, the adaptation process being done in stages.* All the reformers noted that the process was *done for each grade separately,* starting with the *first grade curriculum and then the next stage and so on.* Each grade's adaptation took *several meetings and was extended from one month to two* according to the reformer R1.

For the sake of clarity, the separate parts of the adaptation process are discussed in detail in what follows.

#### 6.3.3.1 The nature of the adaptation process

All the reformers agreed that the adaptation process covered the terminology of the content, methods of lesson presentation, objectives, teaching plans, spelling mistakes, images and examples to bring them closer to the students' needs, environment, society-culture and religion.

*We reviewed each part of the science curriculum to make sure that it was relevant to the students and did not conflict with Islamic norms. For example we reviewed the examples and pictures in each lesson, lesson presentation, spelling and the evaluation questions after each lesson. We also reviewed the curriculum objectives to be sure that they could be fulfilled by the new curriculum, and the teaching plan to be sure that it was aligned to the content of new curriculum and the period in question of the academic year (R7).*

The adaptation process was continued through many meetings of the committee, as they all asserted. They debated the amendments at each meeting. The nature of the adaptation process is described by one of the members (R5):

*We held many meetings in which we reviewed and commented on each lesson and its related content, pictures, examples and language, objective and teaching plan. When we had finished the work of adaptation, our comments and views were sent to the Assistant Undersecretary for the Curricula Sector for ratification.*

When I asked the reformers to comment on some examples of amendments, the reformer (R5) replied:

*I remember that we modified some examples in the lesson on predators in the second grade to relate more closely to the students' environment. Moreover, we corrected some grammatical mistakes, altered and added some images in the lesson on Light and some others and reformulated some goals so as to be more explicit.*

Two of the reformers, however, had a different view of the curriculum adaptation, suggesting that the amendments made to the new science curriculum for all stages were very limited and most of them concerned language mistakes in the textbook.

*I was a member of the adaptation committee and attended all the meetings and I can say that the amendments were very limited, for example, changing one or two pictures and correcting some of the words in the science textbook (R7).*

In this regard, the reformer R8 added:

*The adaptation process focused on the science textbook alone. In contrast, no attention was paid to the teaching plan, curriculum aims and the education objectives in science.*

All the reformers agreed that certain factors influenced and guided the adaptation process. These factors are discussed in more detail below.

#### 6.3.3.2 Factors influencing the adaptation process

The factors which influenced, guided or were taken into account in the process of curriculum adaptation included those to do with culture and society, Islamic norms, the students' everyday lives and their levels of ability. These are discussed in turn below.

##### 6.3.3.2.1 Culture and society

All the interviewed reformers stated that the culture and society were important factors to be taken into account when the new science curriculum was being adapted and they agreed that the curriculum, to be successful, had to be relevant to the students and teachers. They understood that without adaptation the new science curriculum was not closely related to Kuwaiti expectations *because it was designed in the USA.* But they *did their best* to bring the two closer together and now *think it is suitable for Kuwaiti students (R3).*

Some reformers highlighted the practical way of adapting the curriculum, as described by one reformer (R6): *From my experience and confirmed by many scientific studies, Kuwaiti society has some cultural practices which need to change, such as: consumerism, lack of productivity* [Kuwait doesn't have industry or cultivation], *obesity, smoking and pollution, so we did our best to find science lessons which would encourage the students to be healthy and producers in society rather than just* *consumers and so that a healthy society can develop their country in the future.* He added*, but at the moment I can't remember these lessons.*

All the reformers interviewed agreed that they worked hard in the adaptation process to relate the new science curriculum (including content, objectives, examples and images) with the Kuwait socio-culture and they reviewed each component of the curriculum. However, after implementation some of the teachers and students felt that the new science curriculum was still insufficiently related to the Kuwait society and culture. Also, all of the reformers agreed that this new curriculum needs reviewing now after being implemented to explore if there are some lessons, objectives, examples and images that need further review. On this point, reformer R1 commented: *I appreciate the teachers' and students' views about the new science curriculum and relating it with the Kuwait social-culture and I believe the new curriculum needs more review and evaluation to develop it. I want to thank you for your research and I hope your research finding will help us to develop the current curriculum, and I ask you to give me a copy of your thesis when you have finished.*

#### 6.3.3.2.2 Islamic culture

Another factor which influenced and guided the adaptation, as all reformers mentioned at their interview, was the norms of Islam. An overall majority of the interviewed reformers confirmed that the life of students, like that of everyone else in Kuwait, is influenced by the Islamic religion. They thought that for the students, Islam was not only a religion but their way of life, because the behaviour of most of them was influenced by Islamic beliefs. This point is explained by a reformer (R9):

*The Islamic religion and culture affects lifestyle ... because everyone does every day what the Islamic religion ordains, such as daily prayer and eating only Halal food, and women wearing the Hijab (head covering) and other things, while abstaining from things that detract from the sanctity of Islam such as drinking alcohol and eating pork.*

All the interviewed reformers confirmed that they had adapted the new science curriculum to be suitable and not to conflict with Islamic beliefs; the adaptation included the text of the lessons, pictures, examples and curriculum objectives. Five of the interviewed reformers believed that the new science curriculum had received very limited amendment, mainly some pictures and examples; some are mentioned by a reformer (R2):

*We reviewed and revised some of the examples to conform to Islamic beliefs and changed some pictures which were inconsistent with them. Only limited amendments were made to the new science curriculum. For example, one was in the science curriculum for grade 6 in the lesson on sound, which had a picture of a man and a woman dancing at a party. This situation conflicts with Islamic beliefs.*

Another reformer (R3) had a different view of the question. He confirmed that it was important in Kuwait to relate the science curriculum with Islamic norms but thought it would have been difficult to recast all the lessons in Islamic terms because some scientific facts are independent of Islamic beliefs.

*I think it is difficult to relate each part of the science curriculum to Islamic norms; for example, how can the lesson in grade 7 on chemical reactions be related to Islam? This applies to other lessons as well.*

**6.3.3.2.3 Daily life**

The interviewed reformers confirmed that they were interested in relating the new science curriculum with the daily life of the Kuwaiti students and encourage them to use science in their daily life and to solve some of the everyday problems which they may face.

*The students spend most of their time outside school so the science curriculum has to help students to use the science outside school. We reviewed the new science curriculum to make sure it relates to students' daily life and helps them to use the science in their daily life. Tthis is one of the aims of the new science curriculum (R6).*

Most of the interviewed reformers agreed that the new science curriculum is well related to Kuwaiti students' everyday lives and encourages them to use science to solve everyday problems. But one of the reformers (R4) disagreed, saying:

*I think the new science curriculum is not closely related to the everyday lives of Kuwaiti students and they need more [examples] because very few of the lessons are linked to it.*

#### 6.3.3.2.4 Students' abilities

Most of the interviewed reformers (seven) confirmed that they had adapted the new science curriculum to be within the grasp of the Kuwaiti students and they hoped the new curriculum would help to improve the students' abilities and skills in learning science. All of the interviewed reformers indicated that the Kuwait students abilities to learning science are weak and this had been confirmed by many studies: they are weak in the learning skills such as critical thinking, problem solving, investigation and forming conclusions, and they hope the new science curriculum will contribute to improvement of the Kuwaiti students' skills and abilities to learn science.

Some of the reformers described this stage of the adaptation process, for example R9:

*Many studies such as the TIMSS test results confirmed that the Kuwaiti students have little ability to learn science and their learning skills are weak, so we hope that this new curriculum will help them to improve their skills and abilities. We reviewed the content, style of lesson presentation, teaching plans and objectives and are sure now that they are suited to the students' abilities.*

### 6.3.4 Phase four: Curriculum implementation

After the phase of adaptation, the new science curriculum was introduced into the schools. All the interviewed reformers confirmed that after they had completed the final version of the new curriculum it was sent to the Assistant Undersecretary to ratify and then be printed and distributed to the schools teaching it. The curriculum was implemented gradually, as confirmed by all the reformers. They stated that the new science curriculum was implemented in stages: the new science curricula of the first and second grades were implemented in 2008, and the third, fourth and fifth grades added the following year (2009). The (intermediate) sixth and seventh grades were added in the 2010 school year, the eighth grade in 2012 and the ninth grade in 2013.

All the reformers knew that the new curriculum had not been piloted in schools before its actual implementation and that it was implemented in all the schools of Kuwait simultaneously. All the reformers agreed that *the first two years of actual implementation would be the piloting period. Within two years, the views and reactions of the teachers, students, academic specialists and parents about these curricula* would be considered, to suggest how it could be developed (R1). He went on to say that *some curricula, such as those of the primary schools, had been implemented more than two years ago without reviewing or evaluation until now,* but he hoped that it would be done *as soon as possible (R1).*

Four of the reformers conjectured that the reason why the curriculum had not been piloted was the time limit on the curriculum reform process which had been set by the MoE.

Only two of the reformers opposed the idea of implementing the curriculum in all schools at once. They would have preferred it to be piloted in a particular group of schools before its wider implementation because this would have helped them to explore its pitfalls and alleviate them before they affected many people. This view was put forward by the reformer R5:

*It is assumed that the new curriculum had been tested. I think that the Ministry of Education rushed to implement it, justifying that it had previously been taught in other countries. But I think that this was mistaken since the nature of each society is different. However, as I mentioned, the final decision is always made by the officials of the Ministry of Education and unfortunately, some reformers supported the idea of not piloting the new curriculum in advance.*

#### 6.3.4.1 Teachers and new curriculum implementation

For the science teachers, according to all those who were interviewed, it was surprising to suddenly have a new curriculum, without any preliminary training, at the beginning of the school year.

*The school year in Kuwait starts in mid-September. On my first day, I was surprised to see the new curriculum. I thought that the Ministry of Education had delivered it to me for review or for information only. To my surprise, the Ministry of Education* *required me to teach the new curriculum for the students immediately without any training or piloting, even though it was quite different from the old curriculum that I had taught to classes up to the previous July (T10).*

Nine of the interviewed teachers agreed that the failure to pilot the new curriculum before its implementation in schools had deprived them of the chance to be informed and to review it. They did not feel that they had had *enough time before teaching* and this had *affected them negatively.* The Ministry of Education had not allowed enough time for teachers to become *familiar with the new curriculum [which was] completely different from the old one.* They claimed that *some topics were difficult to understand* and that it was hard to deliver information to the students (T11), because most of the lessons were new and the method of explaining the lessons in the new textbook was novel and completely different from the one used in the old science curriculum, so some difficulty could have been expected. The difficulty of the lessons also had a negative impact on the students' understanding. Most of the teachers felt that some or all of these problems could have been avoided if the curriculum had been tested beforehand.

#### 6.3.4.2 Students and new curriculum implementation

The reaction of all the interviewed students was similar to that of the interviewed teachers. The students indicated that they were surprised to find a new curriculum at the beginning of the school year and had found it completely different from the old one. All the interviewed students confirmed that they had not known that *the science curriculum would be changed.* They agreed that it was *difficult to understand most of the new lessons because they were explained in a complex way*.

The students' views on the new science curriculum are presented in more detail in section 6.5 under 'Students' perspective on the new science curriculum'.

### 6.3.5 Challenges of the curriculum reform process

The interviewed reformers referred to the following range of challenges and difficulties which may have affected the reform process; they had encountered them in the process of reforming the science curriculum:

#### 6.3.5.1 Centralism

Centralism was the main challenge that faced seven of the reformers in this curriculum reform. Six of the interviewed reformers stated that they had criticised the centralised function of the MoE, as well as the centralisation of the science curriculum reform process in all its phases, notably the formation of the reform panel and the selection, adaptation and implementation of the new science curriculum. They mentioned that although *most of the work is carried out by the Education Inspectors, frankly the final decision is always taken by the Assistant Undersecretary for the Curricula Sector,* who receives recommendations, feedback, amendments and views before taking the final decision.

Three of the interviewed reformers affirmed that they would have preferred to engage science teachers and ask their opinion, but this did not take place. The choice of a pre-written curriculum is one of the decisions that in the eyes of some of the interviewed reformers indicates the centralisation of the work.

*I have a preference for the Al-Obeikan company's curriculum and more than one other reformer also does. Some of my colleagues and I noted down our views when we participated in the reform process and I spoke personally with the Assistant Undersecretary for the Curricula Sector and expressed my opinion in some meetings. Ultimately, the final decision was made by the Assistant Undersecretary and decision-makers in the MoE for their own reasons, the most important of which was the financial cost, as I said before (R6).*

#### 6.3.5.2 The limited time period allowed for the reform process

Four of the interviewed reformers stated that the Kuwait government in the person of the Minister of Education set a specific time within which to complete the reform process of the science curriculum and confirmed that this time was *not adequate* for choosing and modifying a new curriculum. Although, as R2 said, *we worked quickly so as to finish early, of course some mistakes* were inevitably included *in the new science curriculum (R2).* This limited time period was one of the reasons which left too little time for piloting the curriculum before the wider implementation of the new science curriculum.

### 6.3.5.3 Financial support

Three of the interviewed reformers state that certain factors relating to the policy of the country had affected the process of curriculum reform, stressing that they had been allocated a financial budget from the government of Kuwait and that there was only a limited amount for the development and reform of the science curriculum, which could not be increased.

*We received many proposals from different companies which produce a series of science curricula. However, we excluded some of these proposals, not because they were not good, but because the price was greater than the budget allocated by the government of Kuwait for this purpose (R3).*

### 6.3.5.4 Adaptation standard

Five of the interviewed reformers confirmed that the process of curriculum adaptation faced a problem in the diligence and personal opinions of each reformer. These reformers say that *there is no explicit 'standard' to follow in the process of curriculum adaptation*. The sequence of action allowed each reformer to express his views on every point which he wanted to revise in the curriculum. Then the committee reformers discussed these views and either approved them or not. These reformers think that these prolonged discussions left the committee short of time. *If there had been an agreed 'standard' procedure for carrying out the process of revision and adaptation,* said R2, *maybe we would not have faced this problem.*

## 6.4 Teacher perspectives on the new science curriculum

Having reported the findings about the process of reform and how it was undertaken and by whom, I next discuss the findings from the interviews with a number of science teachers, their views on the new science curricula, which are explored in some detail. The intention is to answer the research question: *What are the teachers' views on the new science curriculum in grades six and seven of the intermediate stage?* Seven headings were found contributing to this theme, namely: the social culture, the Islamic culture, students' abilities, teaching methods, student assessment, teacher recommendations, and challenges. These subheadings are presented below.

### 6.4.1 Social culture

Most of the science teachers who were interviewed agreed that the new science curriculum is not altogether what is called for by the society's culture, structure and needs. These teachers think that several topics linked to the students' lives are missing and should have been taught. As one teacher said:

*There are many issues and problems that Kuwaiti students must learn from the science curriculum, such as the problem of desertification. Since Kuwait is a desert country facing this problem, it ought to be explained to the students, together with the way to solve it. Another example is oil, the most important source of wealth in Kuwait, on which its economy depends. Teachers supposed that the importance of oil and how to benefit from it should have been topics to address, but the new science curriculum doesn't relate closely enough to the students' needs and everyday lives (T1).*

On this point, T9 added:

*According to international medical reports, the health problem for most Kuwaiti schoolchildren is obesity. The science curriculum should have contained such subjects, which are the most serious health problems in the country and their risks, their causes and how to avoid them. Other problems were ignored, such as air pollution, soil pollution and desertification. Unfortunately, the new curriculum, and indeed the previous curriculum, contain few topics of this kind that relate to the students' lives.*

The effects of not relating the content of the science curriculum to the students' social culture were discussed in some of the interviews with teachers. They confirmed from their experience in teaching science that only when the content of the science curriculum has some bearing on the students' society, culture, needs, everyday life and environment were these lessons easily understood by the students because they felt that these lessons were related to their culture, daily lives and needs. They added that the lessons which are more related to the students' culture, needs and daily lives play a role in the development of the country and the creation of future scientists, who would use science to solve their country's problems and help it develop.

Teacher (T5) agreed, and added an example:

*Many lessons in the new science curriculum are not related to the students' culture and everyday lives and I noted sometimes that the students have difficulty in understanding the content. In contrast when I mention examples from the student's familiar environment, society and culture, students can understand the lesson. For example, in the lesson on mammals, the picture and examples of animals in the textbook were unfamiliar and it was difficult for the students, but when I showed pictures and examples such as the camel, it became easy and interesting to them.*

I observed this in practice in two of my classroom observations; one of these observations was in grade 7, in a lesson on 'Exploring the Earth'. I observed that the teacher presented some pictures from the Kuwaiti environment, and the way in which most of the students were interested and were keen to discuss this point with the teacher, and some of them explained their experiences which related to this lesson. The teacher confirmed that the examples and pictures in the textbook were not related to conditions in Kuwait and had therefore brought other pictures and examples to show the class. This science class was one of the best classes which I observed. I observed that most of the teachers lack experience in relating science with the students' culture and needs and most of them did not try to relate it and just depended on the explanation of the lessons in the textbook.

Regarding the objectives of the new science curriculum, four teachers in the sample mentioned that these objectives are not closely linked to the culture of their society and wondered how in this case the students could benefit from studying science subjects.

*The objective means something that I want to achieve. For an objective to be achieved, it should be linked as far as possible to the culture of the society in which the student is living, but unfortunately not many objectives [in this curriculum] were connected to the students' society, culture or needs (T3).*

However three of the teachers who were interviewed took a different view of the science curriculum and its links with the social culture of the students. They agreed that it was important to relate the science curriculum to the students' social culture, but they pointed out that science is a general subject and its topics cannot all be related to the students' social culture because in their view science takes in every single thing in the world. Regarding the new curriculum, they found that in some ways it related to the society and culture of Kuwait and could be developed in the future.

*The science subjects take in many things in this world so we can't make science relate to our society and culture alone because this will make the students concentrate too much on their own country and this is wrong (T10).*

In general most of teachers had negatively views about relating the new science curriculum with the Kuwait social culture and they called for reviewing this curriculum again to be more related to the students' culture, daily lives and needs, because this will help to improve the students' attitude toward science and will help them to understand science more easily.

### 6.4.2 Islamic culture

Most of the teachers who were interviewed believed that the new science curriculum did not link very well to the students' Islamic religion and culture, because it contained no examples from the Holy Qur'an and the sayings of the Prophet Mohammad (the 'Hadith') basic to the religion. These teachers affirm that when evidence from the Holy Qur'an and Hadith is provided in science lessons, this increases the confidence of the students in the facts and findings of the lesson, which leads to improved understanding.

*Islam is the official religion of Kuwait and all Kuwaiti students are Muslims. The Holy Qur'an and sayings of the Prophet (Hadith) are the most important books on which the Muslims depend in their everyday lives. Thus, when a Quranic verse or Hadith is mentioned in the lesson, this will assist the student to understand the lesson easily and trust the facts illustrated in the lesson because the Islamic religion greatly affects the students' beliefs and daily lives (T4).*

T11 mentioned some examples of science lessons which can be related to the Qur'an and Hadith:

*In spite of the fact that science does not conflict with Islam and many verses from the Holy Qur'an and Hadith, such as the Day and Night, Seasons and Reproduction, can interconnect with it, [the new curriculum does not cite them].*

Some of these teachers agreed that the textbook does not praise the Arab Muslim scientists of the past who developed science or made scientific discoveries, such as Ibn Sina, Ibn Al-Haytham, Al-Khwarizmi and others, even though the inclusion of those scientists would have encouraged students to pursue their journey of discovery, research and learning.

*Unfortunately most Kuwaiti students do not complete their study of science. From my point of view, students should admit this. The science curriculum should emphasise the role of past Muslim scientists in developing the subject, to encourage students to study and love science, but unfortunately the new curriculum makes no mention of Muslim scientists (T2).*

Still, three teachers had a different opinion. They agreed that it is important to relate the topics of the curriculum with the Qur'an and the Hadith of Mohammad and that the current curriculum did little to advance this, but maintained that it would be difficult to do so in every lesson or even most of them. However, they said, a teacher could at any time bring out in class the connections with Islam – they did not need to be spelled out in the textbook. One said:

*I sometimes quote certain verses from the Holy Qur'an and notice at once that the students quickly and easily understand the lesson. Such parallels are possibly best drawn by the teacher. It is not a requirement that the verse should be printed as part of the lesson, but it is better to write the verse so that students can read it (T7).*

In three of the classroom observations I observed in that their teachers mentioned Quranic verses which related to the lessons and that the students were interested in them; most of the students knew these verses of the Qur'an and they also understood these verses very well. In addition, I noticed that they made a note of these verses and understood the link between these verses and the science lessons. The teachers of these observations indicated that although no Quranic verses or Hadith are written in the science textbook, when they feel it appropriate, that they relate some science lessons to the Quranic verses and that this is very helpful for them to explain the lessons to the students and also useful for the students to understand the science lessons more easily. This also agreed by most of the students in these observations in which they indicated they understood the science lessons more easily when they related to verses from the Qur'an or Hadith of the prophet Mohammed.

Most of the teachers interviewed agreed that many of the images and examples in the textbook bore little relevance to Islamic culture; indeed some of the images were hostile to Islam, including photos of wine and of parties where the genders were mixed. These teachers remarked that such pictures could be replaced by others, such as those of a woman wearing a veil, a gathering of people of the same gender in a mosque or familiar animals in the students' environment.

Two teachers asserted, with those above, that it would have been better if most of the pictures and examples had related to the Islamic culture, but in contrast they had a different attitude to the non-Muslim pictures and examples. They thought that such things had little effect on the learning of the students, because today's technology covered the whole world and students could nowadays see similar scenes online, on TV, i-Pads, i-Phones or any technologically advanced machine.

Regarding the science lessons which conflict with Islamic beliefs, seven of teachers disagreed with teaching these lessons because they felt these would negatively affect the students' Islamic beliefs. In contrast, there are two teachers who held a different view in which they considered that science is for all and all science lessons have to teach students, regardless of whether or not it conflicts with the Islamic religion.

*Now the world is like a small village and most of students have new technology machines and the internet and they can read, see and know everything they want, so to ignore the scientific issues which conflict with the Islamic religion is not useful. From my point of view I think these scientific issues which conflict with the Islamic religion must be taught to all students and argued with the Islamic and Qur'an verses. I think this is better than to ignore it (T1).*

Six of the teachers (a majority) mentioned that the current objectives are not linked to the culture of Islam and that there is no apparent objective of linking the science curriculum to the Islamic culture in the future.

*I do not consider that any of the objectives connect to the Islamic culture, where all objectives focus on scientific topics (T9).*

Nonetheless, five teachers stated that it was not important or necessary to connect all the objectives to the Islamic culture, so long as some could be:

*It is sufficient that there are some objectives relating to the Islamic culture, because these are science subjects,* but not to Islamic Education *(T1).*

### 6.4.3 Students' abilities

Seven of the science teachers interviewed found the new science curriculum for grades six and seven quite unsuitable in terms of the students' abilities, giving as the reason that *the new science curriculum was designed for students of higher ability and did not take into account our students' abilities (T3), which, according to studies conducted in Kuwait or international tests and studies like the TIMSS exam have proved medium or weak [in solving problems, investigation, research and critical thinking skills].*

These teachers also mentioned that the method of explanation in the new curriculum for this level resembles the explanation method in university textbooks in depending on wordy statements and long explanations with few examples and photos. Further, this method doesn't tell the students what the intentions of the lesson are, or what its useful or important points are, that should be focused on. They confirmed that this method is difficult for Kuwaiti students, because they are not accustomed to it. In the words of one of them:

*The method… is similar to the writing in novels and stories. In my view, this method is not appropriate for someone who has the ability of an intermediate school student (T1).*

Asked about the information included in each lesson in the new science curriculum at this level, six of the respondents confirmed that there was too much information in the lessons of the new curriculum for the students. The result was a loss of concentration among the students, who found it hard to understand the lesson. These teachers told me that the new curriculum is well known for the abundance of information in its textbook, which made it hard for students at this level to understand everything. On top of this, T9 added, *information in some lessons overlaps with information elsewhere resulting in a loss of the students' focus.*

Still, three teachers thought, in contrast, that the new science curriculum for grades six and seven was suitable for the students' abilities. However, three other teachers thought instead that, while the explanations in the new curriculum were different from those in the former, the new explanations were better because they developed each student's thinking skills. They noted that the method of explanation in the lessons of the new curriculum depended on the student and not on the teacher; they gave the student a chance to think, research and solve problems, whereas the old curriculum gave him information directly, without developing his thinking skills.

*I think the new curriculum is better than the old one at developing thinking skills because it leaves them up to the student. The current curriculum …gives the student the headline or the chance to research and solve the problem (T6).*

**6.4.4 Teaching methods**

All the teachers who were interviewed confirmed that teaching science successfully demands different teaching methods, which could each be varied, including lecturing, discussion, cooperative learning (in groups) and self-learning, when the student gets the opportunity to conduct practical experiments, deduce the results and find solutions. Seven of the respondents affirmed that they were generally forced to use the lecturing method, although they knew that other methods might be of more use to students, for the following reasons: the great quantity of content, the amount of information to transmit in each lesson and the shortage of time. *The amount of content of the new curriculum is too large, that it prevents me from varying the use of different teaching methods and it does not match the length of the class period, so I am forced most of the time to use the lecture method to save time (T4).*

In contrast, while four of the interviewees accept that the large amount of content in the new curriculum precludes the use of different teaching methods, they do not believe that this is the main reason for not using them. The other reasons cited are lack of encouragement, no appropriate rooms, poor information on different teaching methods and how they could be used and failure to provide adequate training courses for teachers.

*The new curriculum may not encourage or help in using different teaching methods, but, from my point of view, this is not the main reason, but one of the reasons (T11).*

One of the respondents gave a reason of his own: that students themselves do not help the teachers to use different teaching methods. This teacher said: *As I see it, the students ... [discourage me] from using different teaching methods. I can control them using the lecture method. I have also learnt that the level of most students does not permit them to conduct scientific experiments by themselves or to use self-learning methods (T7).*

The schools' facilities, classroom design and lack of the proper teaching tools were further hindrances to teachers who tried to diversify their teaching methods. These were mentioned by eight of the teachers interviewed. These teachers indicated that the classroom arrangements do not much help the division of students into groups and that each school has at most one or two laboratories, too few for all the science sessions; this obliges teachers to hold some of their sessions in ordinary classrooms. Three of the teachers added other reasons, such as lack of encouragement by the MoE to develop professional skills in teaching methods:

*The Ministry of Education does not care much to develop the teachers' skills in teaching methods and does not provide training courses for teachers on teaching methods and ways of using them. I knew about the different teaching methods through my academic study, but I have not found any communications [about them] from the Ministry of Education since I joined the teaching staff (T2).*

When I observed some science classes I could see that most of the teachers used lecturing or some other teaching method that put them in front of the students, where they explained the content and finally, if time allowed, gave students the chance to read the lesson in the textbook and answer the evaluation questions. The students' role in this method was merely that of listening to the teachers and answering questions if the teacher asked them. From the observations and when I asked these teachers after each observation about the teaching methods which are used in the class, they indicated that they used these method for the reasons listed above. I can confirm the shortage of facilities in schools because all the classrooms contained only students' tables, chairs and a whiteboard, though some also had a TV, smart board, video and overhead projector. I observed in each school I visited and saw that there were only one or two science labs. I have taken some photos of the science classroom and present it in this study (Figure 6.1) to make clear for the reader to see the facilities of the classroom in Kuwait.

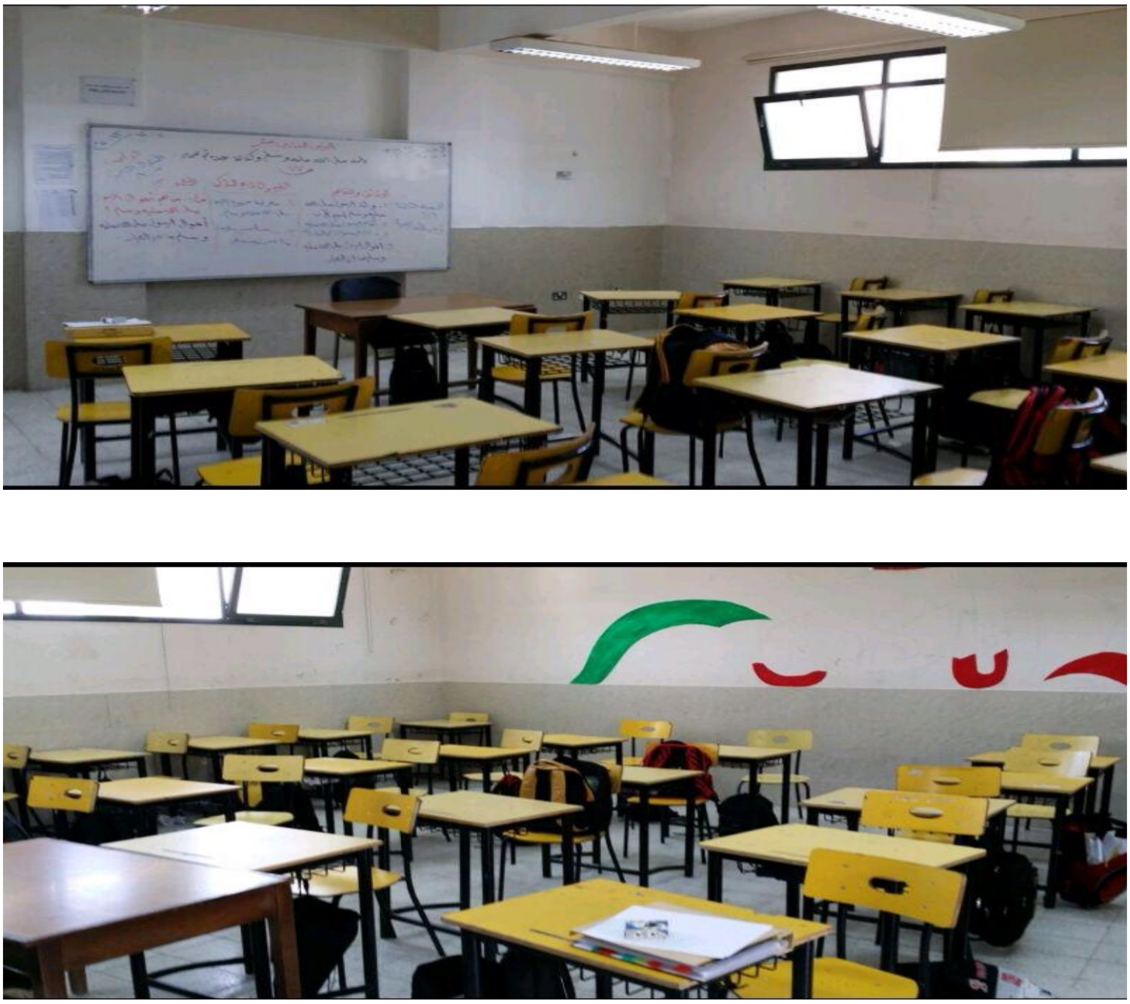


**Figure 6.1**: The classroom of the intermediate stage school in Kuwait.

In addition, I observed that the science lab also didn't have many facilities and that most the science lessons are taught in the classroom rather than in the science lab (Figure 6.2). I observed the cooperative learning method in use only twice, each time in a science lab, and these lessons were practical; each group of students worked together under the teacher’s supervision to conduct scientific experiments and I could see that the students were happy, cooperative, interested and motivated.

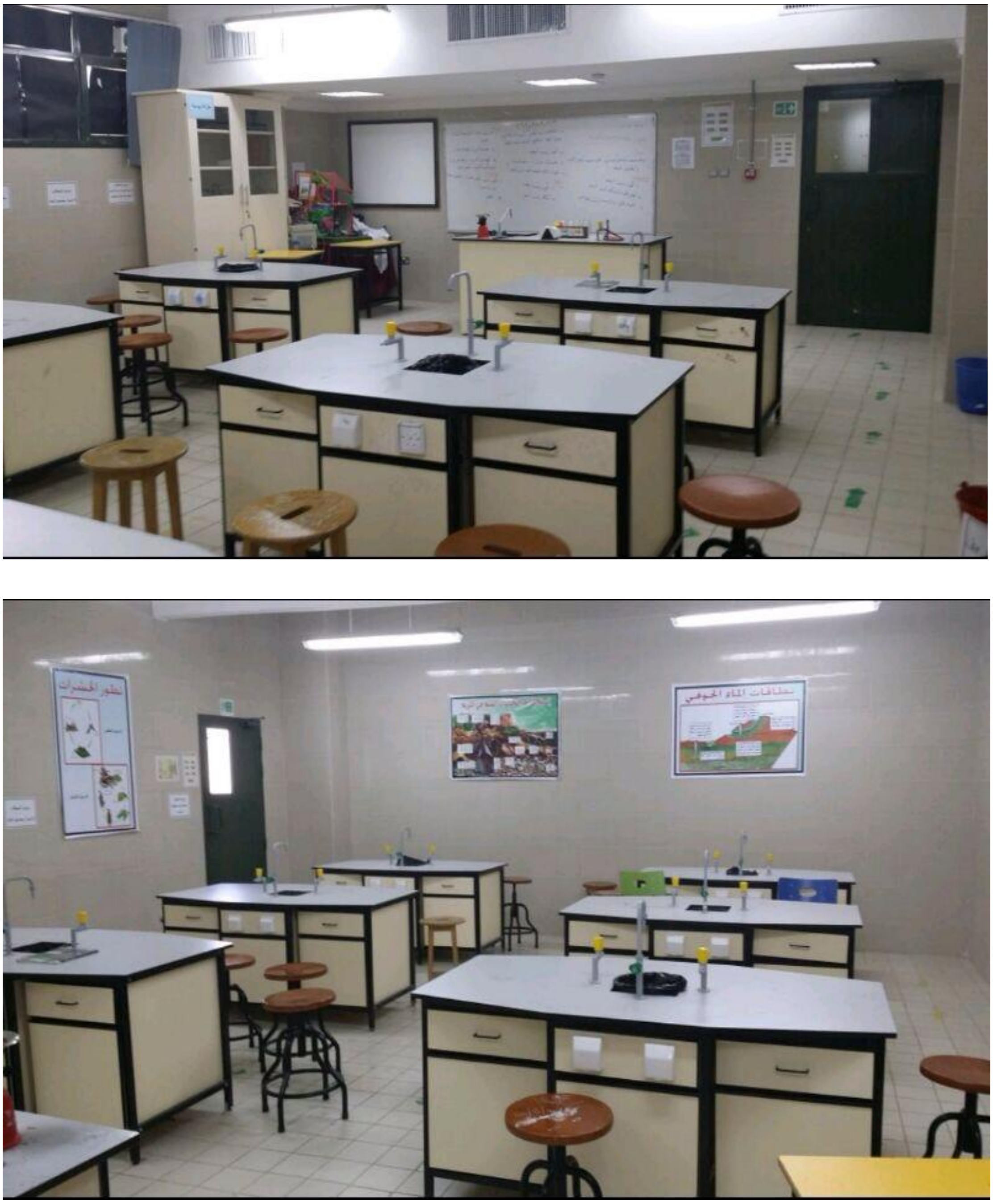


**Figure 6.2**: The science lab of the intermediate stage school in Kuwait

### 6.4.5 Student assessment

Regarding the new assessment system for students, all of the teachers who were interviewed stated that Kuwaiti students give most of their attention to passing the exams, because they must pass in every subject in order to move on to the next grade.

Seven of the teacher respondents indicated that the new assessment system which had been part of the reform does not measure the students' abilities nor does it further the interests of the student. Indeed, as they confirmed, the new system of assessment puts students under higher pressure. While the former system was divided into eight, i.e. the student was examined eight times and could use a high score in one exam to make up for a low score in another, the new system halved the number of opportunities to compensate and some students might not find any way to make up for a low score in an exam. This puts them all *under great pressure* to gain *as many marks as possible.*

*In my view, the new assessment system is not in the student's interest. It does not give the student opportunity to make up in the summing-up of marks. In the previous system, there were (8) examinations and the examination score total was out of (15) marks, but currently, there are (4) examinations and the score total is out of (35) marks. Thus, the students are under great pressure because they feel that their chance is low and as many as possible marks should be achieved (T1).*

Moreover, five teachers felt that the teacher's role in the new students' assessment system was curtailed because in the new system the scheme for distributing the score allocates most of the marks to the examination, whereas the previous system had allocated a good proportion of marks for participation, activity, solving homework problems and attendance, as well as behaviour in class.

These teachers find that this curtailment has had an adverse impact, as (T10) described: *Unfortunately, passing the examination is the most important goal of the students in Kuwait, regardless of whether they have benefitted or not. The students know now that the teacher awards the grade in a few areas and therefore, they have started to ignore classroom activities and homework. Some students are not controlling their behaviour in the classroom because they know that a student's conduct cannot change his grade, though it could in the past.*'

Nine of the respondents believed that they nowadays had a very limited role, for which T6 gave these reasons:

*The science students' exams are designed and prepared by the science inspectors in the Ministry of Education, who also set the date and topics for the students' exams.*

*The science inspector sends the exam to the school one day ahead of the exam date and the role of the teachers is merely to mark it.*

These teachers indicated some of the effects of the limited role of teachers in the students' assessment; they complained that the science inspectors did not teach the students and did not know their individual weaknesses and strengths – sometimes the exam was a difficult one for the students. In addition, they felt that they had had no chance to use different methods, such as oral or practical exams, of assessing the students because the MoE had restricted the format to written exams only.

### 6.4.6 Challenges

The teachers who were interviewed defined many of the factors that they found challenging in the teaching of the new curriculum; for example, centralisation. They would rather that the MoE cooperated with them to alleviate these difficulties, as is discussed in detail below.

#### 6.4.6.1 Centralism

Centralisation was the main challenge in teaching the new curriculum, according to the respondents. All the teachers concurred that the workings of the MoE and its staff are centralised: all the education decisions are taken by the MoE and sent for implementation to the teachers, who had not taken part in any educational decisions. The respondents highlighted that some of these decisions affected the teaching of science in the schools and one of them referred to the new science curriculum reform process. They were sure that all the educational decisions in respect of the science curriculum reform process were taken by the MoE without giving the teachers any role in the reform process, and it was then sent to the teachers for implementation.

In addition, all the respondents asserted that they were limited to the topics in the school science textbook and they are not allowed to bring any other resources to the teaching of science. As one teacher (T3) complained, *this hinders me from being creative in teaching science and makes the science class boring.*

*With the Ministry of Education system I can't use other resources to teach science in the school. We have just the science textbook as a resource and we are obliged to teach the topic in this textbook only.*

Some of the other MoE decisions have been influential in the teaching process, such as the teaching plan for the new science curriculum, which all the teachers confirmed had been sent by the MoE at the beginning of the academic year. It included the textbook lessons which had to be taught and the time allowed for teaching each lesson. The teachers were told to stick to this plan without exception, though they all agreed that they had had no part in designing it.

*At the beginning of each school year, the Ministry of Education sends the teaching plan of the curricular content, which includes the lessons that I have to teach with the time required for each lesson and some suggestions for the way of teaching. The teachers have been instructed to follow the teaching plan set by the Ministry of Education and may not make any revisions to it (T4).*

T9 described the effect of this decision on his teaching:

*These issues hinder my creativity in teaching and obstruct the development of my teaching skills. The teacher should have some freedom in teaching students.*

Nine of the teachers interviewed criticised the MoE for centralising the new student assessment system process also and confirmed that the exams, exam times, exam lessons and exam marks are controlled and designed by the science inspectors in the MoE, ignoring any role for the students themselves in the way that they were assessed.

*I can't control the students' assessment and I have to comply with the conditions for the students' exam, which is prepared by Ministry of Education; otherwise, I will be accountable. Likewise, my students must sit no other test because the examinations are also prepared by the Education Inspectors of the Ministry of Education. These issues hinder my creativity in teaching and obstruct the development of skills in teaching (T1).*

#### 6.4.6.2 Lack of instructional tools

Ten of the respondents believed that the provision of teaching tools necessary for teaching was a problem for them, in particular those relating to the new curriculum. They claimed that the schools do not provide these tools on the pretext that they are not obtainable from the Ministry. Therefore, some teachers revealed that they had managed to meet the cost of the necessary tools from their own pockets:

*With the implementation of the new curriculum, the teaching tools are scarce or unavailable. Many of the teaching tools which were used in the old curriculum are no longer viable. In addition, although we have repeatedly requested the school to provide these tools, unfortunately our request has not been met (T7).*

In many schools, new technological equipment such as TVs, ipads, ipods, smart boards, computers, videos and overhead projectors is not available; this was confirmed by nine of the interviewees. These teachers were sure that such new tools would help them to teach science in more interesting and creative ways, but had had no chance to use them.

I observed when I attended some science classes that most of the teachers used simple instructional tools such as a white board and pictures. I saw a teacher using the overhead projector only once and I did not observe any electronic tools in use. The teachers told me that such things were not available in their school.

This was agreed by most of students interviewed (22) who indicated that home is a better place for learning science because they feel there are not the appropriate facilities in the school, such as the new technology tools like iPad, computer, overhead projector, video and TV. All of the students interviewed had iPads at home and they are experienced in using them, in addition they would prefer to use these new technology tools to learn science because this would help them to understand the science easily and make the science class enjoyable.

*I use the iPad in my home to read some books, watch films and play games and I have experience in using the technology tools such as iPad, iPhone and iPod and there are some useful programs installed on these tools, so I think it would be useful to use them in the school for learning, and I think it will make the class enjoyable, interesting and help us to understand the science easily (S24).*

#### 6.4.6.3 Lack of time

Eight of the teachers who were interviewed agreed that too little time was allocated for classes and that the school year was not long enough to teach the new science curriculum. They confirmed that each lesson includes much information and that explanations of each topic were often impossible to cover in the time allowed. These teachers stated that the new curricular content is too large to be commensurate with the length of the school year and that they took some of the class time from their colleagues in other subjects to fully cover the curricular content.

I saw in my observations that the full lesson could be explained in six of the sessions, while in four others the class time had expired before the teacher could complete the explanation. For both the laboratory sessions that I visited and observed, the class time had ended before the teacher and students could complete the experiment and the teacher had had to postpone the lesson to the next class, even though under the educational teaching plan set by the MoE a single lesson should have been enough.

From the observations I found a number of reasons for the failure to finish the explanation of the lesson in one session in the time allowed for it. Among these were the great quantity of subject matter and the amount of information, which, in my opinion, needed two sessions – some teachers agreed with me. I noticed that most of the teachers were trying to stick to this plan. A contributory cause is that, because the science laboratory in most schools is some distance from the classrooms, the students take a long time to go from the classroom to the lab and take their seats. This subtracts 5-10 minutes from the session time. Another reason is the failure of some teachers to control the students; it can take some time for the teachers to persuade the students to listen and pay attention, which diminishes the time available.

The teachers whom I observed agreed that these were their reasons for not completing the lesson in time. Two of them added that the teaching plan prepared by the MoE was not adapted to the content in some lessons, which required two or more sessions but were allocated only one by the planners.

#### 6.4.6.4 Professional development programme

Most of the teachers' interviewees had not been trained with respect to the new curriculum and how to use it. Teachers generally teach the new curriculum without being trained in its content or ways of teaching it. Most of them had not reviewed or even read the new curriculum, as they had not been offered training courses or workshops before the new curriculum was introduced to the schools.

*No training course or workshop concerning the new curriculum has been offered to me to attend, particularly before applying the new curriculum in the school. I teach the curriculum directly without any training course, although I have not reviewed or even seen it before at all (T11).*

These teachers indicated that the lack of training made it hard to teach the new curriculum because it was completely different from the former one and they had been surprised to find it in place at the beginning of the academic year.

Although three of the teachers who were interviewed had attended training courses on the new science curriculum prepared and organised by the MoE, these courses were held only after a full academic year of teaching it. As one teacher noted, *The… training course [was] held at Ministry of Education headquarters for five days at four hours per day, with science education inspectors discussing the goals and content of the curriculum. The course was not of great importance to me because I had already taught the new curriculum for a year (T7).*

All the teachers who were interviewed confirmed that the MoE had shown no interest in courses to develop teaching skills, although all of these teachers agreed on the need to develop them and to keep pace with the latest teaching methods.

*[In] more than 11 years … the Ministry of Education has provided only one training course on the cooperative learning method and then for only five hours. I do think the Ministry is interested in providing teachers with training courses (T1).*

### 6.4.6.5 Large class size

Nine of the teachers who were interviewed agreed that the high number (28-35) of students in their classes adversely affected the teaching of the science curriculum. These teachers affirmed that when the class is large not all the students can participate and discuss; in addition, the teacher sometimes loses control of classes which are too large. They also told me that when scientific experiments are being conducted in the lab, too few chairs and tables are provided for the class.

I could confirm this from my classroom observations. At the beginning of a visit, I counted from 28 to 35 students in each classroom. I also observed in some classes that the teacher lost control of the class and that not all students had a chance to discuss what they wanted with the teacher and the participants in classroom activities. When I asked the teacher about this, he replied that the cause was the large number of students in the same room.

#### 6.4.6.6 Additional work

In addition to the fundamental role played by the teacher in school, i.e. teaching, the school or the MoE assigns other tasks which have nothing to do with teaching. Most of the teachers who were interviewed stated that such tasks adversely affect the teacher. Among them are monitoring students daily to check the attendance in the schoolyard during break time and being mandated to supervise and administer an educational stage, as (T5) described: *The teacher may be a supervisor for the 7th grade; the role of supervisor is to follow up and resolve students' problems, ensure the punctual attendance of teachers in classrooms and check the presence or absence of students, despite the fact that the teacher has classes to teach*.

The school administration requests teachers to take charge of an activity with a group of students, e.g. the teacher may be responsible for an activity such as agriculture, or the school library, etc. Some teachers have the additional task of selling goods in the school cafeteria during break time, as T11 reveals:

*A group of teachers in each school are elected for the school cafeteria, where they daily sell commodities, procure the goods demanded and conduct the financial accounts of sales and purchases and submit them to the school administration.*

Five of the respondents said that the school manager required them two or three times a month to stand outside the school until the last student leaves even if takes several hours. They have the duty of making sure that all the students go off with their parents and no student remains in the school.

All the teachers who were interviewed confirmed that these additional tasks adversely affected a teacher's performance and teaching, put him under pressure and caused him to fail to perform his basic job well, which is to teach the students.

### 6.4.7 Teachers' recommendations

Within the science teachers' interviews some recommendations were given by most of the teacher interviewees to develop the science curriculum and science education in Kuwait. These recommendations are discussed as points in this section.

- Involve the teachers in the all MoE decisions which relate to teaching science, such as: science curriculum reform, preparing the teaching plan and developing the system of student assessment.
- Develop the new science curriculum to be more related to the students' needs, culture, society and environment.
- Develop the new science curriculum to be suitable to students' abilities and to encourage them to study science in the future.
- Develop the teaching science objectives to be more achievable within the science curriculum.
- Provide training courses for teachers to develop their teaching skills.
- Provide new technology tools for teaching and learning in the schools.
- Give the teacher the freedom to use different sources to teach science in addition to the science textbook.
- Exempt teachers from any additional tasks in school to give them the chance to focus on the process of teaching science and to be creative with it. Develop the new science curriculum to be suitable for the period of the school academic year and class sessions.
- Decreasing the number of students in each class.

There are the main recommendations from the science teachers. After this discussion of science teachers' perspectives, the next theme is related to the students' perspectives about the teaching and learning of science in school.

### 6.5 Students' perspective of the new science curriculum

This theme attempts to answer the research question: *What are the students' perspectives of the new science curriculum in grades six and seven in intermediate stage?* Five categories were constructed under this theme and these were: attitudes to learning science, science content, effective ways of learning, modes of assessment, and student recommendations. These categories are presented below.

#### 6.5.1 Attitudes towards learning science

All of the student interviewees agreed that science is not an interesting or favourable subject to study because they find the lessons of the science subject are difficult to understand, complicated, boring, not useful, and do not stimulate them to continue their science study in the future.

*I do not prefer to study science and feel it is not an interesting subject because the science lessons are boring, not very useful and do not help me in my daily life (S17).*

Almost all of the students interviewed (28) confirmed that physical education (sport or PE) is the best subject they prefer and like to learn. The students have mentioned some of the reasons that make them like the physical education course: they practise their hobbies such as playing football, basketball, volleyball, and handball during the physical education class. Some of these students (10) added that they like to learn the physical education subject because its examination is easy and that the marks allocated to the practical test are more than those of the theoretical examination.

*The best subject to me is physical education because I like playing football, and in the PE course I play football with my colleagues, also the PE examination is very easy. I do not prepare for the examination, yet I get the full marks (S23).*

Through I discussed this point with the students, a group of students (18) said they prefer to study Islamic education for a number of reasons, such as they like to hear historical stories of Islam, and the prophets. These students indicated that they prefer to study the Islamic education subject because it relates to their daily life and teaches them how to pray, fast, make pilgrimage, and all things relating to Islam.

*I like the Islamic education subject more because it teaches me what I need in my life such as: prayer, fasting, pilgrimage, alms (Zakat), and recitation of the Qur'an (S4).*

In addition to the physical education and Islamic education subjects, the students mentioned the art education, computer science, social studies, and Arabic language as their favourite and interesting subjects.

### 6.5.2 Science content

Most of the students interviewed (22) agreed that the current (new) content of the science curriculum makes it difficult to understand most of the science lessons. These students stated that most of the science lessons they study are complicated, difficult to understand, there is too much information in each lesson, and contains such terms that are incomprehensible or not familiar to the student.

*Many science classes are incomprehensible and involve a lot of information and words that are not understood and difficult. I had been preparing for four days before the science examination, but I did not achieve good grades in this exam (S5).*

Through the discussion with the students for this point, I found that most of the students (18) in the study rely on a private tutor who comes to their homes to teach them the science lessons. These students state several reasons that compel them to take private tuition, such as that the science lessons are difficult and could not be understood by them during the class time, and when they review the lessons at home alone, they also find it difficult to understand most lessons, which contain a lot of information and new terms that need to be understood. Among the reasons also is the huge amount of science classes. The students state that many lessons should be reviewed and studied before the examination, and that they need assistance to review and understand all of these lessons soundly before the examination. In view of the fact that the school or the teacher does not provide classes for the student to review the previously taught lessons before each examination, the student uses private tuition to study the science course.

When I asked the students, *what topic do you find most interesting and prefer to study in the science subject?* most of students interviewed (25) indicated that they prefer to study topics which relate to their society, culture, daily life, and which help them to use science in solving the problems facing them, stating that they understand the lessons relevant to their life more easily than the rest of the lessons.

*My favourite lessons are those relating to my life, as well as the lessons that I can do at home, such as scientific experiments. I prefer to go home and perform these experiments (S1).*

In the examples of these topics which the students preferred, they confirmed that they understood the topics which teach them how to use science to solve some of the problems they face in their life. These students give some examples of this in action, such as the knowledge of how to extinguish fires.

*I learned from science that air helps with ignition. One day, a TV caught fire in our house, which resulted in burning of the curtain in the room. My mother wanted to open the door and window for [smoke to go out and] fresh air to enter, but I told ask her not to do so. When the fire-fighters came, my mother told them what happened and that I had prevented her from opening the windows. 'The action of your son is correct', they replied. 'If you had opened the door or the window, the fire might have possibly spread to the whole house because of the air stream' (S11).*

There was another group of student interviewees (12) who added some topics which they were interested to study in science, those topics which related to their health and body, or in other words, biology topics because they feel they related to their daily life. For examples of these topics, some students mentioned:

*I like the topics which teach me how my body works and how I can maintain my health (S30).*

*The interesting topics in science are those that relate to the human body, such as heart, brain, eyes, and teach me how they work because these are relevant to me (S21).*

*How humans and animals grow up and reproduce are interesting topics in science (S4).*

In contrast, most of students interviewed (26) do not prefer to study the physics topics in science and they indicated that these topics are complicated and difficult to understand.

*I am not interested to learn the physics topics, such as scientific laws of energy movement, and I feel these topics are complicated, boring and are difficult to understand (S15).*

Related to the current topics in the new science curriculum, most of students interviewed (24) confirmed that most of the lessons they have in the current science curriculum do not much relate to their daily life and do not teach them how can they use science in their daily life. In contrast, another group of students interviewed (9) mentioned different views in which they indicated that there are some topics related with their life but they see it as not enough.

*There are a very limited number of the topics that relate to my daily life or how I can use the science in my daily life, and most of topics are general (S3).*

These students indicated that the current science curriculum has many examples and images in the textbook that do not relate to their environment and they didn't recognise some pictures, such as of animals and planets.

*In the Animals topic in the textbook there are some images of animals that I'm seeing for the first time and I asked my teacher, what is it? Also the same in the Plants and Weather topics (S13).*

In addition, most of students interviewed mentioned that they prefer to see the examples and images which relate to their life because this helps them to understand the topics easily.

*In the topic about the plants which can live in a hot environment it was the first time I had seen the images of the plants in the textbook and it was difficult for me to understand this topic in the beginning, but my teacher gave us some examples from my environment, like the palm tree, which helped me to understand how these plants can bear the hot weather and lack of water because I have palm trees in my garden at home and know it has long roots, and I had seen it before (S8).*

Relating to the science topics and the Islamic religion and culture, a group of students interviewed (11) confirmed that the new science topics do not contain any Quranic verses or Hadith, and they indicated that the inclusion of verses from the Qur'an in the science topics would enable them to understand the lesson better and more easily.

*With respect to the Planets and Stars lesson, I was not convinced that the Earth revolves and that there are many planets in space orbiting without colliding. When my teacher quoted a verse (Surat Al-Raad: verse of thunder) from the Holy Qur'an and indicated that this is so, only then was it confirmed to me that this really is possible, and I understood the lesson (S11).*

### 6.5.3 Effective ways of learning

Related to the effective and enjoyable different ways of learning science, most of the students interviewed (20) stated that the most effective and enjoyable way to learn science is the practical work in the science lab, and working in groups. The other group of students interviewed agreed that they would prefer the lessons in which they work for themselves, and in which they take part and use the tools, such as viewing living cells through a microscope or carrying out a magnetic attraction/repulsion experiment. These students confirmed that the classes in which they use the tools and work by themselves are easier and understood faster by them.

*The most effective way of learning that assists me to understand the lessons quickly is when the teacher asks me together with my colleagues to conduct a scientific experience or use the tools in the lessons, such as microscope, scales, models, etc. I like this method better than to sit and listen to the teacher while he explains the lessons (S22).*

Some of the students (15) preferred going on science trips out of the school such as visiting a science museum, going to the desert to see the rocks and other materials and visiting any place which relates to the science lessons.

*I am happy when we go on science trips out of school and I find it an enjoyable, effective and interesting way of learning science (S2).*

In addition to practicals and science trips, the other effective and enjoyable way of learning science that were mentioned by most of the students were looking at videos and doing science investigations in the science lab. Copying notes from the board and textbook were not preferred by most students interviewed; in contrast, these students confirmed that the most frequent ways of learning used in reality in the current science classes are copying notes from the board and textbook. Relating to this point, S20 mentioned:

*The most usual way I used to learn science was copying the notes from the board, teacher and textbook because the teacher didn't encourage or direct me to use any different ways, although I prefer to use practical ways and work in a group with my friends in the science lab or in class, and I prefer to go on science trips.*

During the classroom observations I observed that the most used method of students' learning is to have the lesson explained theoretically by the lecturing method, and the students listen to the science teacher during the explanation of the lesson. At the end of the class, the teacher either asks them some questions and holds a discussion about the lesson, or lets them read the lesson silently from the textbook and solve the appended questions.

### 6.5.4 Modes of assessment

The students' views regarding the new assessment system are that they are not satisfied. Most of the students interviewed (20) state that the new assessment system is dependant to a great extent on the written examination only. It does not consider the student's activity in the classroom or school, the extent of his participation and interaction with the teacher in the class, and the level of his commitment to perform the homework required by the teacher. They confirmed that the teacher currently has discretion over a few marks only, and most grades are given to the written examination. These students agreed that this is unfair to them because the examination score is not the only measure of the student's level. They agreed that one examination only per semester implies injustice to them because they know that if they do not achieve a high score in this examination, there is no other way for compensation in another examination, which leads to the failure of the student in the science course. These students state that under the old system, if the student did not attain a good score in the first examination it was possible for him to compensate in other examinations.

*Unlike the old system where marks were given for my participation, behaviour inside the classroom, and performance of homework, the new system is unfair because it depends on the score of the written examination only. Now, the teacher has a few marks only, and everything depends on the examination scores. If I have not achieved a good score in the examination, I will fail in the science course even if I were* *excellent in the classroom during the year, as the highest marks are given to the written examination (S11).*

The other reason that most of the student interviewees (19) consider as one of the adverse aspects of the new assessment system is that most of their assessment depend on written examination: in contrast, they prefer to be assessed by different methods such as practical, oral and students' activities.

*I prefer that they assess me by different methods such as practical, oral and my activities and cooperation in science class. I think the current assessment system is unfair because the most marks depend on a written exam and this put the students under high pressure (S29).*

Some groups of students interviewed (11) indicated that the new student assessment system makes the most important object of students in learning science to pass the written exam; on this point S16 mentioned:

*There are high scores for the written science exam and I need to pass this exam to pass to the next school grade, so my main object of learning science is to pass this written exam.*

### 6.5.5 Students' recommendations

The students who were interviewed gave some recommendations to develop the science curriculum and science education in Kuwait. These recommendations are discussed as points in this section below.

- The science curriculum should include more of the practical lessons which encourage the students to conduct the scientific experiments on their own.
- Relate the new science curriculum more to the students' daily lives and needs to help the students to use the science in their daily life and to solve these problems.
- The new science curriculum should be slimmed by including fewer topics, to allow for more in-depth explanations.
- Provide the new technology tools for teaching and learning science in the classroom and science lab and encourage the students to be participants in using these tools to learn science.

- The science teacher should give the students the opportunity to discuss the science in the classroom with the teacher and with other students.
- Diversity of the teaching methods which are used for teaching science such as cooperative learning and problem-solving.
- Diversity of the assessment modes by using different modes of assessment, such as: practical exam, module exam, oral exam and classroom activities assessment.

### 6.6 Summary of chapter

In this chapter, the qualitative data obtained from the reformers, the science teacher and student interviews, and the classroom observations were presented and discussed under the main themes: the factors that guided and influenced the science curriculum reform process, the phases of the science curriculum reform process, the teachers' perspective on the new science curriculum and the students' perspective on the new science curriculum.

This chapter highlighted the perspectives of the science curriculum reformers, the science teachers and the students with regard to the science curriculum reform process for grades six and seven. One of the most important findings from the qualitative data in this chapter is the centralism of the Ministry of Education's work system, as all the educational decisions, including those related to curriculum reform, teaching plans and student assessment, are made by the decision-makers at the Ministry of Education without any role for the teachers or students in the decision process.

According to the qualitative findings of this study, the science teachers hold negative views of the new science curriculum, and a particular negative of the new science curriculum is that it is not clearly related to the students' social culture, Islamic culture and social needs, nor is it clearly related to the students' abilities, daily life and environment. The findings indicate that the science teachers are faced with a number of challenges that prevent them from successfully teaching the science curriculum, including the centralism of the system, the lack of training courses, the lack of teaching tools, the large class sizes and the heavy workload.

The findings also indicated the negative views of the students with regard to the new science curriculum; the findings highlighted that most of the students have difficulties learning science, and most of students find the science classes to be boring and uninteresting. In addition, the findings show that most of students prefer not to learn science, and they will not continue studying science in the future.

In the next chapter, the findings of the qualitative and quantitative data are discussed and related to the previous literature in the context of this study.

# Chapter 7

# Discussion of the Research Findings

## 7.1 Introduction

The study findings were collected in three ways: through questionnaires completed by the science teachers and students of grades six and seven, through classroom observations, and through interviews with students, science teachers and the science curriculum reformers who were responsible for carrying out the science curriculum reform process for science in grades six and seven, at the intermediate stage in public schools in Kuwait. One aim of the questionnaires, interviews and observations for the science teachers and students, it will be recalled, was to investigate their views on and attitudes to the new science curriculum which was implemented in 2010 in grades six and seven in the public schools of Kuwait. The other aim was to explore the difficulties which teachers and students face with this new curriculum and to offer suggestions for remedying them. The science curriculum reformers were interviewed in order to find out how and why the reform process was carried out, and who was responsible for this reform process. The results of the study were meant to clarify and shed light on the negative views of and attitudes to the new science curriculum among both teachers and students, from which it was clear that neither group was satisfied.

The purpose of this chapter is to discuss the most important findings of this study, relate them to the research questions and compare them with the previous studies already discussed in Chapter Three, the literature review; these earlier studies are briefly discussed in this chapter.

The present chapter is divided into ten main sections, as follows: Brief answers to the research questions; The phases from top to bottom in reforming the science curriculum; Centralisation in reforming the science curriculum; Teachers' autonomy in teaching science; The socio-cultural context and the new science curriculum; The Islamic religion and the new science curriculum; Student attitude to learning science;

Methods of teaching and learning the science curriculum; Instructional tools in teaching and learning science; and Conclusion.

**7.2 Answers to the research questions**

Before discussing the findings the answers to the research questions are briefly discussed, according to the findings from the teachers' and students' questionnaires, the interviews with teachers, students and reformers, and the classroom observations. These answers are as follows:

**RQ1:** ***What were the factors that guided and influenced the science curriculum reform process in grades six and seven of the intermediate stage?***

The findings indicated that there were some factors that guided and influenced the reform of the science curriculum. These factors are: the social culture, the Islamic religion, social needs, students' abilities and the science education system in Kuwait. In addition, the findings confirmed the importance of these factors and that they must be taken into account to develop the science curriculum in the future.

**RQ2:** ***What were the phases of the science curriculum reform process in these grades?***

The phases of the science curriculum reform process are confirmed by the findings of the reformers' interviews. The first phase was to select the new science curriculum series, the second phase was adapting this new curriculum to suit the students' society, culture, religion, daily life and needs. The final phase was implementing it in schools. In addition, the findings indicated that these phases are controlled by the group of science inspectors and some of the MoE staff, chaired by the assistant undersecretary of the curriculum sector in the MoE. The science teachers and students did not participate in these phases nor in any step of the science curriculum reform process.

**RQ3:** ***What are the teachers' views on the new science curriculum in these grades?***

The findings showed that most of the science teachers have negative views about the new science curriculum and felt that it was not clearly related to the students' social culture, Islamic culture and social needs, nor is it clearly related to the students' abilities, daily life or environment. The findings indicate that the science teachers are faced with a number of challenges that prevent them from successfully teaching the science curriculum, including the centralisation of the education system, the lack of training courses, the lack of instructional tools, the large class sizes and the heavy workload.

**RQ4:** ***What are the students' views on the science curriculum?***

The findings showed that most of the students have a negative attitude toward learning science and find the science lessons boring, difficult to understand, uninteresting and unhelpful for using science in everyday life. The findings indicated that most students are not interested in becoming scientists and do not prefer science as a study subject; most of them study science merely to pass their exams. Regarding student assessments, the findings showed that most students disagreed with the current exam assessment system and preferred diverse forms of assessment, such as a combination of practical and oral tests and course work assessment. The students suggested some ways to develop their science learning, such as: adding more practical lessons, relating the science lessons to their daily life problems, limiting the content of the science curriculum and providing new technology tools for use in class.

## 7.3 The phases in reforming the science curriculum

This section is related to the answers to the first two research questions (RQs 1 and 2). It was shown by the findings from the reformers' interviews that the process of reform and development of the science curriculum took place after the previous science curriculum had been taught for more than fifteen years and that the aim of the science curriculum reform was partly to keep up with the scientific, technological, economic and social advancement and development of Kuwait and the rest of the world, and partly to teach the students to apply science to the development of their country, using it to solve problems in their everyday life. These science curriculum aims were discussed by Kesidou and Roseman, (2002) who identified that the science curriculum should to keep up with developments in different contexts: scientific, social, technological and economic, and on the other hand encourage the students to benefit from these developments both in order to solve their daily problems and to bring improvements to the peoples of the world.

The findings from the teachers' and reformers' interviews confirmed that all the science curriculum reformers and the science teachers were agreed on the importance of reforming and developing the old science curriculum because it was out of date and not keeping pace with the world's scientific and technological developments, and did not contribute to develop the students' abilities and learning skills. These findings agree with some studies such as that of Al-Ahmad, (1999) who indicated that the old science curriculum could not encourage the students to use problem-solving skills to resolve scientific issues, but it focused instead on memorisation and recall. In another study, Mohamed (1998) identifies that the old science curriculum did not contribute to development of the students' thinking skills in learning science. In addition, Al-Rashed (2000) concluded that the old science curriculum ignored practical science lessons and focused on the theoretical lessons instead. All these studies and others (Ali, 2000; Al-Quhtany, 1999; Fahad, 2000; Jassim, 2002; Mullah, 2000; and Saed, 1996) have called for the development and reform of the old science curriculum, which had been taught unchanged in Kuwaiti schools since 1995.

The agreement of views between all the teachers and all the science curriculum reformers who were interviewed confirmed the importance of the reform process which the MoE carried out. This reform process and the phases which ensued in this process are described in detail in the present study.

The findings from the curriculum reformers' interviews covered the selection, adaptation and implementation of the new science curriculum (Figure 7.1). The first phase of the reform process was selecting a new science curriculum series by Pearson-Scott Foreman, a publishing company from the US. The second phase was important for the ultimate success of the reform, because it covered the adaptation by the MoE of the new science curriculum to suit and relate to the Kuwaiti students' culture, society, religion, abilities and environment.

This point is supported in studies such as Mansour's (2008), who confirms that the Islamic religious beliefs affect the teachers' and students' attitude toward science because they may not accept some lessons which conflict with Islamic religious beliefs. Mansour concluded that the religion and the social-culture context have to be taken into consideration when reforming and developing the science curriculum. Van den Akker (2003) indicates that the curriculum must be connected to the society and culture of the student; while Fullan (2007) affirms that the curriculum should take into account the student's society, culture and environment. In addition, SCT (Socio-cultural theory) identified that relating what the students learn in the school with their social-culture and daily life will help the student to understand easily (Vygotsky, 1987). This confirms the importance of the adaptation process, in particular because the curriculum was originally designed in a Western country which is different in religion, social and cultural ways from any Arab country. This adaptation importance is argued by Barab and Luehmann (2003), who indicated that the adaptation is a very important phase in the development of the science curriculum but it is not easy and the central challenge for science curriculum designers is how to adapt the science curriculum to meet the needs and goals of the local context and culture. The adaptation process and to what extent the science curriculum reformers adapted the current curriculum to be suitable for the Kuwaiti social culture and religion are discussed later in this chapter.

The third and final phase of the science curriculum reform was implementing it in schools. Regarding this phase, the findings from all participants in this study confirm that the new science curriculum was not piloted in any school and the new science curriculum for grades six and seven was implemented in all Kuwaiti schools at the same time. Besides excluding teachers and students from its reform and development process, the findings indicate that the implementation of the new science curriculum took place without giving the teachers or students the opportunity to review it beforehand and without any training courses in preparation for the teachers.

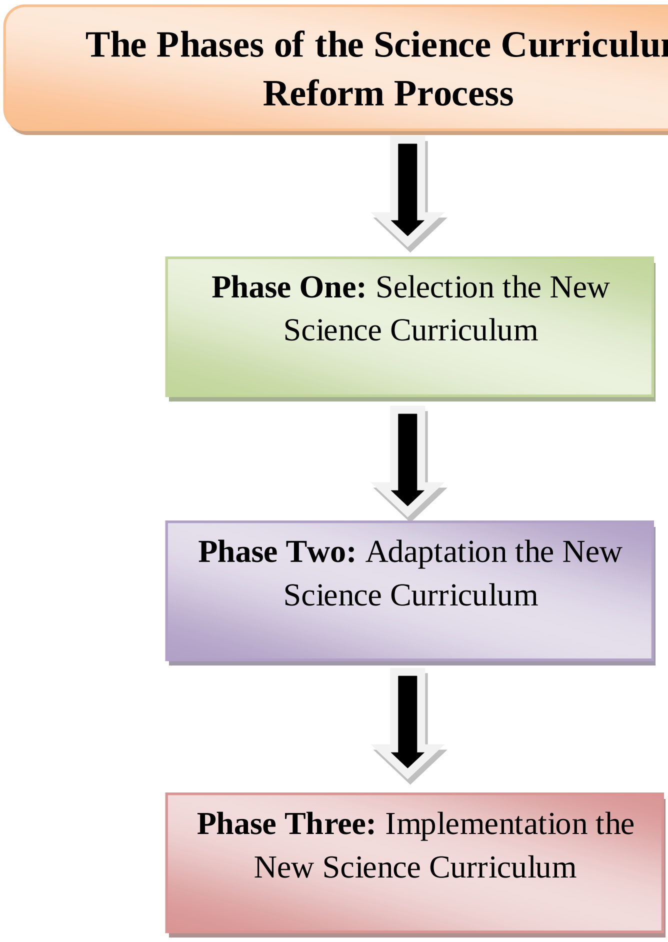



**Figure 7:1** The phases of the science curriculum reform process in Kuwait

The findings showed that the teachers and students were taken by surprise by the new science curriculum at the beginning of the new school year, for it was completely different from the old one and this caused some difficulties for both sides, in particular at first. This may explain why the teachers and students found it so difficult to teach and learn the new science curriculum.

Piloting the new curriculum in a few schools before the full implementation is important in any curriculum reform and development process. This point is made by Corbett, et al. (2013) study in which the authors find that new curriculum piloting helps to reveal mistakes and obstacles and listening to the views of the early users of the curriculum would have helped to correct these mistakes and develop a better initial version, which would have succeeded without further alteration. Implementing the new curriculum directly in the school without piloting it may have a negatively impact on the teachers' performance in teaching it and this will reflect on the student understanding (Al-Shaiji, 2011). This may explain the difficult which faced the teachers and students in teaching and learning the new science curriculum which was confirmed by this study's findings from the interviews and questionnaires.

Regarding this failure to go through a piloting process and train the teachers in the new tasks, the findings from the teachers' interviews and questionnaires confirmed that most of the teachers agreed that they had faced difficulties in teaching the new science curriculum and needed a training course to familiarise them. In addition, most of the science teachers added that the MoE are never interested in providing professional development programmes for teachers which relate to developing teaching skills, although most of the science teachers agreed that a training course would have played a great part in such development. Some teachers admitted that the MoE had arranged training courses for some teachers, but only a year or two after the new science curriculum had been implemented and they had started to teach it. They thought that their course was rather important and useful, but it had come too late.

These findings are consistent with Rugh's study (2002) stating that Kuwait, and Arab countries in general, do not always provide training courses or any professional programmes for teachers, although these would help contribute to teaching skills. These countries are not interested in providing professional development programmes and training courses for their teachers. In contrast the study by Ayres et al. (2002) emphasised the importance of developing the teaching skills and knowledge of teachers, since this contributes to a developed teaching technique and will impact positively on the students' learning. Ayres et al.'s (2002) study confirmed that teachers are constantly required to develop their teaching skills and keep up-to-date with the pace of progress in the field of teaching methods and improved professionalism.

With regard to these findings, the lack of professional development programmes also resulted in these teachers' difficulties when the new science curriculum was introduced and their negative views and attitude to it, which, through its negative impact may have affected the teaching of the new science curriculum and reflected on the students attitude toward science. This issue is discussed also in Ball, Jones, Pomeranz and Symington's study (1995), which confirms that the limited teacher training that could support teachers would improve their educational ability to help reform the curriculum and in turn student learning. They added that ''staff development days in education are still being called curriculum days -and they often just have a focus on the students and the curriculum in schools... They should focus on professional development for teachers because that's going to benefit the kids as well.'' (p.21)

The findings discussed above may indicate that the negative attitudes of the teachers and students and their difficulties with the reformed curriculum may not have resulted from a poor quality curriculum, but may be due to the inadequate steps taken to adapting and implementing it. These teachers feel that they are not familiar with the new curriculum and they were taken by surprise by its introduction. The next section will discuss the findings about the centralism of the curriculum reform process.

### 7.4 Centralism in reforming the science curriculum

This section is related to the answer to the Research Questions 1 and 2 (RQ1 and 2). It has been shown in the findings from this study that the reform and development process of the science curriculum was carried out by a group of science inspectors, some staff from the MoE and the assistant undersecretary, who took all the final decisions in the reform process, including the decision to select, adapt and implement the set of science curricula. From these findings it is clear that the reform process was under a centralised system because this close group of persons worked remotely on the reform process, without input from teachers or students, and moreover the assistant undersecretary always took the final decisions. It is clear that the process of science curriculum reform in Kuwait was centralised and limited to a certain number of decision-makers in the Ministry of Education. This is confirmed by Haidar (2000) whose study notes that the work system of the MoE and its decision-making in most of the Arab states including Kuwait is such a centralised process that it is limited to a group of staff employed in the MoE and to decision-makers who make all the educational decisions for the entire process of education, including the development of the science curriculum.

Related to such centralisation, the findings from the science teacher and student questionnaires and interviews with reformers, science teachers and students, also showed that the science teachers and students played no role in this reform and development process. These findings concur with the findings of other studies (such as Haidar, 2000; Rugh, 2002; Shaw, 2006) which were interested in the education in Arab states, which concluded that a role for both teachers and students in most Arab countries, including Kuwait, is never found in any educational decision-making, including the development and reform of the curriculum. Dagher & BouJaoude (2011), writing about science education in the Arab states, add:

> *'Determination of science curriculum goals and objectives in many Arab states is centrally controlled by ministries of education (or similar government establishments) and is rarely an outcome of democratic negotiation between various stakeholders.' (p. 80)*

However, it is important for the success of a process of curriculum reform that teachers and students should take part and express their views on curricular developments, as confirmed by Barab & Luehmann (2003) who identified that 'True reform is a collaborative process and involves working with teachers as partners''(p. 464). A study (van den Akker, 2003) emphasised the need to listen to the views of teachers and involve them in all educational decisions, most of all in the process of curriculum development, since their views contribute to its success. He added that not involving the teachers in the curriculum development and reform process may cause it to fail because the teachers will face challenges in teaching it.

These studies all confirm the importance of the teacher role and views in a successful curriculum reform process and the fact that they were excluded from this reform and felt it had been imposed on them may explain the findings of negative views and attitudes of teachers toward the new science curriculum in the current study. So the new curriculum may be good but the teachers did not accept it and this may have negatively affected their teaching performance and attitude toward it. This explanation is discussed and confirmed in a recent study by Ryder (2014) which focused on the teachers' experiences of external science curriculum reform. Ryder states ''The science curriculum undergoes repeated reform in many countries. However, it is often reported that the enactment of such reforms within schools rarely reflects the intended outcomes of curriculum designers ''  (p. 1). He argued that one of the reasons science curriculum reform failed to reflect the intended outcomes was a lack of teacher involvement in this reform process, because if they are not consulted many teachers do not enact a reformed curriculum as intended by developers.

Furthermore, many studies asserted the importance of listening to the students' voice about the curriculum, which will contribute to the success of the curriculum reform process. One of these is Levin (2000), who in his study of the role of the student in the education reform says ''Education reform cannot succeed and should not proceed without much more direct involvement of students in all its aspects'' (p. 155). A study by Cerini, Murray and Reiss (2003) indicated the importance to listening to the students' views to discover their needs, difficulties and interests, and they asserted that ''decisions that affect students cannot be taken without taking student views into account'' (p. 19). In addition, Leat & Reid (2012) emphasise that students' views of curriculum reforms and development must be discovered and considered: what they want to learn and what concerns they have will affect the success of the reform process.

These assertions make clear the importance of teachers and students as participants, who should give their views on reform and development of science education including that of the science curriculum. But in this particular reform in Kuwait nobody listened to them. As noted above, the centralism of the curriculum reform process may have had a negative impact on the success of the reform because the condition of involving all stakeholders, such as teachers, students, academics and parents, and discussing and considering all their views, was not met. The centralised system of the work of the Ministry of Education puts a wide gap between the teachers and the decision-makers and the lack of teacher participation in decisions touching the education process is among the factors that are directly connected to the nature of the teacher's work and probably helps to create dissatisfaction among teachers with whatever the Ministry of Education provides. In this study context it may be the case that excluding the teachers and students from the reform process led them to take this negative attitude to the new science curriculum.

The above discussion makes it clear that the findings of this study are important as a reference for the policy-makers and education developers because it presents the views of key people who were not made part of the changes, and the consequent challenges and difficulties which faced them. It gives their recommendations and suggestions for modifying the science curriculum and science education.

### 7.5 Lack of teacher autonomy in teaching science

This section is related to the answer to Research Question 3 (RQ3). The findings from the teacher questionnaires, interviews and classroom observations confirm that the teachers are bound by the Ministry of Education in a centralised work system. Their role is most often limited to teaching a science curriculum and implementing this and other decisions from the Ministry of Education without the chance to change it or even to have joined in by proposing modifications. Moreover, the teaching plan of the science curriculum, including the lessons which they must teach, the teaching methods and the time allocated for each lesson is submitted to the teachers who must follow it exactly. In addition, the student assessment system is designed without the teachers' input by the policy-makers in the MoE; the students' exams, examination content and dates are determined by Ministry science inspectors. The students' exams are written by science inspectors and sent to the teacher to be followed in every detail; the current student assessment system gives the teachers no chance to diversify and use different forms of assessment (practical, course work and module).

The findings therefore confirm that the teacher's role in the education process in Kuwait is, without any input, to carry out the orders of the MoE in teaching the curriculum, examining the students and following the Ministry's decisions to the letter.

This situation in Kuwait, with its lack of participation and freedom, is likely to negatively affect teachers' attitude to teaching science and is the background to my disclosure of the findings from this study, which show their negative view of the new curriculum. This point is made also by Al-Hahjry's (2007) study which illustrates the limited role of teachers in Kuwait and naturally leaves them disillusioned. In addition, Al-Enezy (2008) finds that teachers have no freedom in their teaching; this makes them feel undervalued in their vocation and hampers their creativity. He calls for greater freedom in teaching students.

In addition, most teachers also complain of the additional workload imposed by the school administration and the MoE, which they are not free to refuse but which is related to administration and not educational matters. Most of the teachers complained that such additional workload is burdensome, hindering the process of teaching, adversely affecting them and impairing their efforts to focus on the more important task of teaching and taking care of their students. This problem is not new in Kuwait, however; many studies focus on this feature, such as Salem, (2000) and Ismail, (2003) which recommend that teachers should not be assigned so much administrative work that they are heavily burdened and which puts the teaching process at risk.

The fact that teachers cannot participate in educational decisions and that they have no freedom to teach the science curriculum in their own way and assess their own students restricts them and makes them believe that they must merely implement the policy makers' orders without participation or enough involvement in educational decisions. In other words, all the difficulties that are faced by teachers including such a lack of autonomy have a negative effect on the educational process and aggravate the problem instead of solving it, risking an adverse effect on their performance and their dissatisfaction with the profession. It is important to resolve this matter and grant the teachers more freedom and autonomy with their classes to teach the science curriculum in their own way. This underlines the important role of teachers in the education process; they propel its success and ongoing development.

This foregoing discussion confirms the lack of teacher autonomy in teaching the science curriculum, despite the importance given to this issue by some studies. According to Davis (2003) teachers and to a lesser extent students also, benefit from having some autonomy in the classroom because interactive and discovery-based types of learning are more enjoyable and ultimately more memorable than is close adherence to a very rigid curriculum. Archbald & Porter (1994) also believe that teachers must be allowed autonomy in teaching and have involvement in the education process and decision-making. Excluding teachers from taking part in decisions about the education process and the freedom to modify the curriculum may adversely affect teaching performance.

But, as the above discussion showed, teacher autonomy is missing from teaching and from all the earlier decisions about what to teach and how to do it, which descend from the policy makers in the MoE. The teachers' views and attitude to teaching the new science curriculum may easily be influenced by this treatment and this confirms that many factors in teaching the curriculum have yet to be taken into account by the curriculum reformers and education developers. Regarding these factors Ryder (2014) concluded that the science teachers' views about the new science curriculum reform and to what extent they accept this reform or not are influenced by many factors which have to take into consideration when coming to reform and develop the science curriculum. Regarding this point, Ryder (2014) mentioned;

> *In responding to a science curriculum reform teachers are influenced by personal beliefs and knowledge, but also internal features of their school workplace (students, teacher peers, school management) and contexts external to the school (district, state, national educational policies; parental pressures, high stakes testing, school/teacher accountability measures). (p. 19)*

From the argument above it is clear that science curriculum reform is not just about developing and implementing the new science curriculum, but the success of any science curriculum reform strongly depends on the teachers and to what extent they accept the new curriculum or not, and this needs teachers' views to be taken into consideration and for them to be given more freedom to teach the science curriculum as they think best.

In contrast, the findings from the teachers' questionnaire indicate that some teachers think differently. In the results, mostly positive views of the new science curriculum, in general, were expressed by science teachers who had not taught the old curriculum; teachers who specialise in biology, chemistry, physics and geology and those with very short (2-5 years) or very long experience (>20 years). These differing views will be discussed briefly in this section; because the present study does not focus on them in depth since each needs a separate study, but they will be one of the suggested studies for future research (see the next chapter).

All science teachers in Kuwaiti schools must have at least a Bachelor's degree in a specialisation and must specialise also in science education, or in a science such as chemistry, physics, biology or geology. The pre-service teachers have different graduate backgrounds and they will have taken different professional courses and training at university, which may in part account for their differing views about the new science curriculum. Perhaps university training in a science subject is preferable to a course in a college of education. The positive views of teachers who had never taught the old curriculum may result from having nothing to compare it with. In addition, teachers with little teaching experience may be more positive about the reform because they have just come from the university stage and still have much of their original impetus and desire to teach, while teachers with much experience who also have a positive view of it may have such expertise in teaching science effectively that they cope well with the reform. As noted above, such divergent views need more research in depth.

### 7.6 Socio-cultural context and the new science curriculum

This section is related to the answers to Research Questions 1, 3 and 4 (RQ1, 3&4). This section is considered important because this is the first study in Kuwait to be interested in studying the new science curriculum and its effect on teaching and learning science in their socio-cultural context. It is hoped that it can be used as a reference, contributing to the development of the science curriculum.

The findings from the science curriculum reformers' interviews indicated that before they implemented the new curriculum they had to adapt it to be suitable to the students' culture, needs, daily life and environment, but the findings from the teachers and students on this point suggest the opposite. According to the findings from the students' and teachers' questionnaires and interviews, they converged in thinking that the new science curriculum was irrelevant to their culture and needs; they argued that several lessons were not concerned with their social culture, which is Arab and Islamic. The findings also showed that they generally agreed that it was important to relate the content with the social culture because it would have helped the students to understand lessons more easily.

The importance of relating the curriculum with the students culture, daily life, needs and environment are argued and confirmed by the SCT (Vygotsky, 1987), which is used in this study as the theoretical framework. This point about the importance of relating the science curriculum with the students' social-culture is in agreement with some studies, such as by BouJaoude and Gholam (2013) who mentioned, ‘‘The socio-cultural perspectives in science education emerged as important research areas which should be taken into account while designing curricula, teaching concepts and developing views about students’ understandings’’ (p.340). A study by Shah (2012) argued that the social culture should be considered in any reform and development of a curriculum and he states that the curriculum reform process may fail if the content does not relate to the culture of the society, students’ needs and environment and that the students will have difficulty to understand it easily.

This contention may explain the findings which showed why most teachers and students found the new science curriculum is hard to teach and understand, because they felt that the new science curriculum was irrelevant to their social-culture. This point is agreed by Seiler (2001) who concluded that a science curriculum without relevance to the students’ social-culture, daily life and need had a negative influence on the students understanding and they have difficulty to understand these irrelevant lessons. In contrast, making the science curriculum relevant to the students’ social-culture will have a positive effect on the teacher and students’ attitude toward science and will make the science classes more enjoyable (Gilbert, 2010).

In their interviews the MoE science curriculum reformers indicated that one of the aims in modifying the new science curriculum was to relate its content to the needs of both the students and their society, but most teachers argued that the curriculum lacked lessons which would have helped the students to apply science to everyday problems and to develop their country through science. The science teachers cited some examples, such as that the state of Kuwait is economically entirely dependent on oil but there are too few lessons on the uses, importance and processing of oil. Several other examples were also given: inadequate lessons on desert reclamation, the fight against desertification, the benefits of solar energy, and other topics which are deemed to be among the key needs of Kuwait society, also typify the new science curriculum. This is confirmed also by the findings from the students’ questionnaires and interviews, where most agreed that the lessons of the science curriculum were not related to their lives and did not encourage them to use science outside school or to help develop their country and the rest of the world. In addition, the students stated that there were no lessons relating to Kuwait’s particular problems which might be resolved by science, such as those listed above, or the use of science and new technology to develop the country.

The importance of relating the scientific ideas with the student culture and daily life is confirmed by SCT which indicates that everyday concepts and ideas are the basis of understanding, development and acquisition of scientific concepts (Vygotsky, 1987). The omission to relating the science lessons with the students' daily life and needs contradicts what most studies affirm, such as BouJaoude and Gholam (2013), which is that the students ought to be studying topics in science which can be related to the needs of society, as this will contribute to the creation of students capable of enhancing their country. Reiss's (2002) study also affirms that relating the science curriculum to the needs of society promotes its success and helps the students to understand the lessons easily, with a sense that these lessons are important and related to everyday life; this will impact positively on their attitude to learning science and understanding the science lessons.

This above argument may explain the negative views of students about the new science lessons because they felt that these lessons do not relate to their daily life and needs and do not encourage them to use science to resolve their problems.

In addition, the findings from the teachers' and students' interviews indicated that the images and examples in most of the lessons are not, as they would prefer, related to their culture and environment; they emphasised that this would have helped them understand the lessons more easily. This finding may also supply a reason for the negatively effect on the students' attitude to learning science, in that they feel these science lessons are not interesting but also alien and difficult to understand. Harrison's (2003) study emphasised the importance of visual images in expression and communication, because the human sense of sight is the most active. Aikenhead & Jegede (1999) asserted the importance of using visual images in students' learning because this helps to achieve the educational objectives. They added that images attract students' attention, arouse interest and are sometimes exciting. These studies assert the need to link visual images with the students' culture and environment because this helps the students to understand the lessons easily and instils a positive attitude to the subject being taught.

These findings showed that most of the teachers and students feel that the new science curriculum is irrelevant to their culture and their society's needs, despite the stress on relevance by many previous writers. The lack of relevance of the new science curriculum to the culture of Kuwaiti society may be one of the reasons for the negative views of most of the students and teachers in this study, because they feel that science lessons are not important and are indeed irrelevant.

This lack of relevance to their culture and needs may be attributed to the fact that the new science curriculum was designed and published in the USA, a country that differs culturally, socially and environmentally from Kuwait. This agrees with the discussion in BouJaoude & Gholam, 2013, which indicates that many standards and curricula in the Arab states have been adopted from Western countries without regard to the social culture in which they are implemented, thus affecting the perception of their quality and the ability of teachers to integrate science into everyday life. The USA is a more developed country whose students perform better than Kuwaiti students do in international tests such as PISA (Programme for International Student Assessment) and TIMSS (Trends in International Mathematics and Science Study). Yet many Arabic countries, such as the UAE, Saudi Arabia, Oman, Bahrain and Lebanon and Kuwait itself, import and teach a science curriculum from the USA or another Western country to take advantage of its expertise (Alqasemy, 2013; BouJaoude & Gholam, 2013; Dagher & BouJaoude, 2011; Obeikan Education, 2012). So, importing a Western science curriculum to use in Arab states may well be useful to get the benefits from the education in Western countries and this may help to develop Arab education. This point about importing the science curriculum is agreed by many studies such as El-Baz (2009) who claims that the education in Western countries and curricula are better than their equivalents in Arab states, so that importing Western curriculum will contribute to the development of the curriculum and education provided that it is adapted and implemented carefully to take the social-culture context into consideration.

This argument confirmed that the idea of importing the Western science curriculum itself is a good one, and may be useful for developing the science curriculum in Arab states if it is adapted in the correct way. In this respect and in light of the findings of the teachers' interviews, which showed that most of the science teachers have negative attitudes toward Western science, they felt that the current science curriculum reflected Western science and culture rather than their Arab culture and that therefore they were unable to accept this Western science curriculum. This might have a negative impact on teachers' attitude toward science and teaching the new science curriculum and this might reflect negatively on the success of the science curriculum reform process. This point is agreed by Mansour (2010) who indicated that some Egyptian science teachers felt that the science curriculum gives the view of Western science and this ''might negatively affect the students' identities and their attitudes towards learning science or taking up careers in science'' (p. 11).

In respect of relating the science curriculum with the social-culture and the negative views of teacher and students about this issue in this study, the question which emerges here is how can it be related? Should only locally relevant science be included? How should the imported Western science curriculum be taught in a different culture?

This is discussed by some studies which called for balancing local and international culture in teaching and learning science; one of which is Aikenhead, (2008) who emphasises that when the Western science curriculum is imported to countries which have a different culture, such as Asian countries, it is important to have a balance between these different cultures. This will encourage the students to search and get scientific knowledge from any source and culture. Mansour (2010) added, ''Science education should be universal and encourage students to wonder about the natural world and to shape their own scientific thinking. These aims can be achieved by the full adoption of a multicultural and anti-racist perspective on science'' (p. 11). In addition, Reiss (2000) indicated that the science curriculum reformers should think about 'multicultural science', in which students can be helped to see that science is a cultural activity and it is inevitably the case that different cultures produce different sciences.

In this respect, the findings of the teachers' interviews and observation showed that most of science teachers may not have enough experience of dealing with the relationship between teaching science and the multicultural context and this may explain the negative views of teachers about the new science curriculum and the social-cultural context. The teacher professional development programmes need to be in place to familiarise teachers with this issue, and this is mentioned in Aikenhead's (2001) study about science and the multicultural context: ''Most students require assistance from a teacher, similar to a tourist in a foreign land requiring the help of a tour guide. In short, a science teacher needs to play the role of a tour-guide culture broker'' (p. 5)

In addition, it must be admitted that some teachers commented in their interviews that the old science curriculum was also in some lessons not relevant to Kuwait's society, culture and needs, although the old curriculum had been designed by specialists from the GCC.

From this discussion it may be inferred that the problems and the failure to make the new science curriculum relevant may not have arisen in the original American curriculum or from the fact that it had been designed in a Western country. They may result from the fact that the curriculum was not adapted properly to be balanced with Kuwait's social-culture and was not competent to engage the other voices and users of the new curriculum. Or the pedagogy and content of the American curriculum may have been good enough and helpful for Kuwaiti students, only the conditions in Kuwait were not ready for it or it needed more adaptation. In the next sections we will discuss more factors which affected the teaching and learning of the new curriculum.

### 7.7 The Islamic religion and the new science curriculum

This section relates to the answer to Research Questions 1, 3 and 4 (RQ1, 3 and 4). Beside the lack of relevance of the new science curriculum to the culture and needs of Kuwaiti society the findings from the teachers' and students' questionnaires and interviews confirm that most of the respondents agreed that the new science curriculum was not related to the Islamic religious culture and had no lessons connecting science to Islam by citing verses from the Holy Qur'an or speeches by the Prophet Mohammed (Hadith) to support the scientific facts and lessons. Teachers mentioned that some lessons could be linked with Islam, in such areas as the four seasons, evolution of the earth, the human life cycle and the rotation of the planets in space. This is in agreement with Mansour's study (2009), which confirms that it is important for the science curriculum in Muslim countries to be related to the Islamic religion and that the science lessons should include some Quranic verses and speeches by the Prophet Mohammed, which support the lessons and clarify the scientific facts asserted by Islam, making the lessons more approachable.

The findings confirmed that most of the students and teachers prefer to relate science to Islam by mentioning Quranic verses in science lessons and confirmed that this would have helped them to understand the scientific facts easily. In contrast, the findings show that most of the students and teachers found the curriculum to include some lessons, images and examples which conflicted with Islamic beliefs, such as images of alcohol and of women wearing too little clothing, which the teachers and students found unacceptable.

Therefore, the findings in this study make it plain that the new science curriculum is unrelated to the Islamic religion of the Kuwaiti students and teachers, perhaps because it was designed in the USA and was not specifically intended for export. However, such problems were supposed to have been solved in the adaptation phase, this being one of the purposes of the adaptation according to the reform planners. This endorses the view that the blame may lie in the adaptation and not in the original curriculum.

Failure to relate the new science curriculum to the students' religion in turn possibly produces a feeling of conflict and hence of difficulty and a negative attitude among the students and teachers which has affected the students' attitude to learning science in general. The findings show that they dislike the whole subject and feel that science classes are irrelevant and uninteresting.

This argument about science and religion is discussed in many studies, such as Reiss (2010), who mentioned ''Teaching about aspects of religion in science classes could potentially help students better understand the strengths and limitations of the ways in which science is undertaken, the nature of truth claims in science and the importance of social contexts for science. In that sense, considering religion within science education places the issue squarely within the consideration of mainstream socio-scientific issues'' (p. 97).

Regarding Islam specifically, some studies advocate relating it with science (Dagher & BouJaoude, 2011; Mansour, 2008a&b; 2010). These studies confirm the importance of making the science lessons relevant to students by incorporating Quranic verses in some of the science lessons. These studies add that there is no conflict between the Islamic religion and science and that Islam encourages students to learn science, research and explore for themselves, as the Qur'an and Hadith say. In addition, Loo (2001) confirms that Islam in its first few centuries was distinguished by its science and discoveries by many Muslims scientists such as Ibn Sina, Al-Farabi, Al-Razi and others, and that it is important to teach this to students in Islamic countries to encourage them in learning about science, for the exploration and development of their countries, and this will affect students in a positive way toward science.

Comparing these arguments from previous studies of science and religion with the findings from this study, it is clear that one of the main reasons for the negative views and attitudes of the teachers and students of the new science curriculum may be its lack of relevance to Islam. Because it is inconsistent with their Islamic beliefs, they are alienated from it and it is hard to teach this new curriculum successfully. The question should be asked about how can science be related to religion? What about the science which conflicts with the Islamic religion?

In this respect, some previous studies (Dagher & BouJaoude, 2011) discuss the relationship between science and religion and find it varied and complex. They go through a wide range of ways of seeing how to relate the religion with science such as through conflict, independent dialogue and integration (Barbour, 1990). Alexander (2007), for his part, suggest four possible models of the relationship between science and religion: conflict, 'Non-Overlapping Magisteria' (NOMA), fusion, and compatibility (complementarity), concluding that the 'complementarity' model is the most fruitful in relating religious and scientific knowledge, or at least the one offering most benefit. This is supported by Dagher & BouJaoude (2011), which indicates that there is a general tendency to promote the compatibility between religious views and science. But Reiss (2010) indicates that some students do not accept certain items of scientific knowledge or scientific theory at all, such as the theory of evolution, because it conflicts with their religious beliefs. He emphasises that these views should be respected but suggests that the theory should be taught to all students so that they can understand, but not necessarily accept, the scientific worldview with respect to human origins. Teachers should be cautious before teaching it in science classes and the curriculum needs to be developed and the teacher trained, the latter by receiving continued professional development to take care of such problems. This will help the students ‘‘to appreciate the way science is done, the procedures by which scientific knowledge accumulates, the limitations of science and the ways in which scientific knowledge differs from other forms of knowledge’’ (Reiss, 2010, p. 100).

From this argument it is clear that religion and science are compatible and relating science to religion is important. However, it is not easy and teachers must use caution in doing so in their teaching. Regarding the new science curriculum in Kuwait, it is clear now that relating all science lessons to Islam would be difficult, but some science lessons would benefit from the support of Quranic verses and the speeches of the Prophet Mohamed (Hadith), as far as this is possible.

In addition the findings from the science teacher and student interviews showed that most of them do not accept the teaching and learning of science lessons which conflict with Islam. This is agreed with Reiss (2010) which mentions the evolution theory which conflicts with some students, and he comments: ‘‘I do believe in taking seriously and respectfully the concerns of students who do not accept the theory of evolution while still introducing them to it. While it is unlikely that this will help students who have a conflict between science and their religious beliefs to resolve the conflict, good science teaching can help students to manage it - and to learn more science’’ (p. 100).

In this respect, and to solve this conflict between science and religion, El-Baz (2009) argued that the science curriculum should include all scientific knowledge and theories regardless of whether or not they conflict with religion beliefs, and that these conflicts can be argued with respect to religious beliefs. This will contribute to encourage students seek the truth, will positively affect their attitude to learning and develop their investigating and thinking skills (El-Baz, 2009).

As noted above, the problem may not have arisen because the new science curriculum was designed in the West but because it was not adapted well or perhaps because the teachers did not have enough expertise to relate science to Islam. This simply shows how urgently the teachers needed professional development and the new science curriculum needed adaptation in depth, again, involving the teachers and students in exploring, on the one hand, how scientific content can relate to Islamic religious culture and on the other hand, explore how some science lessons, images and examples may conflict with it and discuss useful ways of teaching it to the students.

There are a very few studies which focus on the relationship between science and Islam but there are no studies in Kuwait that are concerned with the science curriculum and the Islamic religion and the importance of relating the two. Hence, the present study is important for exploring the value of relating science and religion and asking how this will develop science education and help students to easily understand the content. This study is also important as a reference for researchers and policy-makers in Kuwait and other countries to develop their science curricula while keeping it relevant to Islam and the related cultural needs of the students and teachers.

### 7.8 Student attitude to learning science

This section relates to the answers to Research Question 4 (RQ 4). The findings from this study's students' questionnaire and interviews show that most of the students have a negative attitude to learning science in school and that they mostly do not enjoy studying it. They feel that it is a boring subject, difficult, lacking in usefulness and not considered a favourable subject for them. Most of them would not want to continue studying science when they reach university, but would prefer other subjects, such as physical education and Islamic studies, because they feel that these subjects are close to them, since most like playing football the best and they can do that in the physical education classes, and they also like to learn about the Islamic religion, such as how to pray, fast and perform the Hajj, which are things that they feel benefit their everyday lives.

From these findings, it is clear that the students prefer to study the subjects which relate to their daily actions, hobbies and needs. This point is made by some studies such as Mansour, 2013 which affirms the importance of taking the students' needs and interests into account when the science curriculum is reformed, and replacements are prepared and developed which will have a positive effect on students' attitude toward science.

Comparing this argument from previous studies with the findings of the present one, as noted, it showed that the new science curriculum is mainly unrelated to the culture or religion of Kuwaiti society and the students' everyday life and this may be one of the reasons for the students' distaste for it. They become bored in science classes and prefer other subjects which they feel are closer to their needs, hobbies and culture.

In addition, the findings confirmed that most of the students disagree with the mode of student assessment in science, which is by modular exams only. They would rather be judged on practical exams or orally and in classroom activities, together with modular exams. These findings are supported by Salman (2005) who recommends using different assessment methods for Kuwaiti students. The findings from this study are different from those by Murray and Reiss (2005), who asked over 350 students in England which mode of assessment they preferred and found that most of them preferred modular exams only. In addition, this study confirmed that some different student assessment methods are used in England, such as coursework, a terminal exam, practical and oral exams and continuous assessment.

The students also indicated that the current assessment system makes passing the exam the main object for most of them, regardless of whether or not they gained other benefits from the science lessons. This shows that the science education and student assessment system in Kuwaiti schools is low in quality, as confirmed by Galal (2013). He criticises the student assessment system in Kuwait and maintains that the current assessment obliges the student to memorise information, which is prone to be forgotten once the student leaves the exam hall. The current assessment often measures a lower cognitive level than it should. He adds that the student assessment system in Kuwait depends on the modular exam alone, which the students are required to pass in all subjects in order to move to the next grade. This puts the student under great pressure and makes passing the main aim for students; to ensure a pass they often resort to private lessons at home. BouJaoude& Gholam (2013) add that the ''assessment practices in science education in many Arab states seem to be focused on recall and lower level cognitive questions'' (p.350). They find that teachers in many Arab states tend to prepare students to succeed in exams without regard to any of the broader curriculum objectives.

Clearly these discussions reveal a failure in the current student assessment system in science and that most students dislike it. This may explain the negative attitude of students to learning science, convinced that the subject is uninteresting; most of them study science only in order to pass the science exam.

In relation to the students' learning in science and the new science curriculum, the findings from this study showed that most of the teachers feel that the new science curriculum does not help to improve the students' scientific abilities and skills. This agrees with some studies (Mullah, 2000; Al-Quhtany, 1999) which indicate that for most intermediate students the ability to develop scientific skills such as critical thinking, investigative skills and self-study skills is weak. They recommend developing the science curriculum to improve this ability through learning science.

Moreover, the findings show that most of the students' responses are identical and confirm those of the teachers; they tend to say that they have difficulty in understanding most of the lessons of the new science curriculum because they think that each lesson is too complicated, confusing and crammed with information. They add that the presentation of the lessons in the new curriculum is different from that in the old one, and is more difficult. The adaptation process of the new science curriculum may not have taken enough account of the level of ability and learning skills of the Kuwaiti students of science when adapting the original science curriculum, which was designed for American students whose skills and abilities in learning science are better than Kuwaiti students', . In addition, the new science curriculum may not have been adapted well enough to contribute to the improvement of these skills and abilities. This is confirmed by Levin's (2000) study, which stresses that the students are the essential part in the education process and the curriculum must be designed with them in mind, necessarily suited to the abilities and learning level of the students because this helps to make the curriculum successful.

To discuss this argument I want to next compare results gained in 2011 by Kuwaiti and American students in the TIMSS. The TIMSS test is given to students in the fourth and eighth grades which are not the same grades as in this study (sixth and seventh), but this comparison is just to show the big different between Kuwaiti and American students in general. Depending on TIMSS test results is supported by Dagher & BouJaoude (2011) who claim, ''The only reliable evidence that is available on the quality of student learning in a number of Arab states is the TIMSS and PISA results'' (p.85). The TIMSS results in 2011 show that the Kuwaiti students scored 347 points in science and were ranked 47 out of 60 countries, confirming the weakness of Kuwaiti students in learning science. The American students in contrast scored 544 points and were ranked 7th. This great difference between the two scores of shows how the American students excel in learning science compared with Kuwaiti students. This result confirms that learning science in the USA is better than doing so in Kuwait, so it may be useful to import an American curriculum for use in Kuwait to develop the teaching of science there but it needs to be adapted carefully.

The findings from the students' questionnaire show that seventh grade and girl students have a more positive attitude to learning science than sixth grade and boy students. The reason for the more positive attitude of the seventh grade students may be that the students in the seventh grade were taught the new science curriculum in sixth grade and were thus more familiar with the new science curriculum being taught in the intermediate stage. In addition, sixth grade is the first intermediate grade, and the students in this grade were newly arrived from primary school and experiencing a new science curriculum. This agrees with Kotte (1992) who indicates that the differences between boys' and girls' attitudes to science widen as students move from elementary to secondary school and the sharpest increase in gender differences in attitudes takes place between the ages of 10 and 14 years. This includes the age of Kuwaiti students in seventh grade, which is 12 years. The finding about girls' positive attitudes concurs with the result of a study by Kibirige, Osodo and Kgasago (2013) which asserts that the attitudes of grade seven girl students in South Africa was positive toward learning science. The girls' attitudes to science, specifically in Arabic states, are influenced by the classroom and cultural contexts in which these girls live (BouJaoude & Gholam, 2013) and this may be something which affects the attitude of Kuwaiti girls.

The reasons for these different views are complex and very few studies, none in the Kuwait context, have concerned themselves with the relationship between the students' views and their gender and grade. The present study does not focus in depth on the relationship between the students' views and their gender and grades either. The relationship and the reasons for it need to be explored in a separate study and this will be suggested among the subjects for future study in the next chapter.

From the previous discussion about the students' attitude to learning science, and comparing the findings from this study with previous reports, it is clear that most students have negative feelings towards science, associated with their sense that science lessons are not related to their life, religion or culture and that the assessment mode in use is not one which they prefer. They also feel that science lessons are hard to understand and include more information than they can cope with. These factors which impact negatively on students' attitude may be ascribed to the fact that this curriculum is completely different from the old one. Its design and way of presentation are also different and unfamiliar to the students and teachers; the latter should have been trained in advance to deliver it. This argument is support by the findings of Prokop et al. (2007) who mention that students' attitude to a school subject were influenced by their teachers' attitude to it. This confirms that the new science curriculum should have been adapted thoroughly and the teachers should have been provided with courses of professorial development.

## 7.9 Methods of teaching and learning the science curriculum

This section is related to the answers to Research Questions 1, 3 and 4 (RQ1, 3 and 4). According to the findings from the classroom observations, the students' and teachers' questionnaires and their interviews, most of the students mentioned that they prefer practical science lessons and also would rather work collectively with each other in the science lessons than use traditional methods such as lectures and declamation. This is corroborated by the findings from the students and teachers' interviews and the classroom observations; in practice, however, most of the methods used by science teachers are still the traditional ones of lecturing, declamation and giving out information directly. The role of the student in class is to listen and take notes from the teacher and whiteboard, rather than discovering facts for themselves through practicals. The findings show that most of the students agreed that they rarely participate in practical experiments and most of the science lessons are taught verbally in the classroom, as opposed to the science lab, although they much prefer to learn science in the latter and conduct their own practical experiments because they feel this practical work helps them to understand the science lessons.

This finding is similar to the findings in the study of Murray and Reiss (2005), which indicated that most of the students agreed that practical work makes it easier to understand the science and gives greater enjoyment of science and that most of them want science teaching to be more practical.

Regarding the reasons for not diversifying the teaching methods, the findings from the teachers' interviews and questionnaires indicate that most of the science teachers do not believe that the new science curriculum helps them to diversify their teaching methods, because it covers a very wide area and all its topics involve copious information which is sometimes written in a narrative way that confuses the students. The teachers added that the class time and academic school year are too short to teach and explain all the content of the new science curriculum and this was confirmed by observation. I noticed that some classes ended before the teacher had fully explained the lesson content. The teachers added that there are not enough facilities in the school and the classrooms to help them diversify the teaching methods in science classes.

This problem is not new, as it was argued as long ago as 1996 by Khaled and again in 2002 by Fahad, who focused on teaching methods in Kuwait and clarified that most teachers were using traditional methods of teaching, such as lecturing. This accustoms the student to obtaining ready information and memorizing lessons in order to retrieve the information at the time of the examination.

The methods which are currently being used for teaching and learning science may be the basis of the students' negative attitude to learning the subject and their feeling that the science classes are tedious, unimportant and of no value to them, because their role is to sit and listen to the science teacher and only rarely involve themselves or work together with a group. Hence they work alone and become bored.

In this respect, the SCT emphasises that the students learn better by social interaction and cooperative learning between teacher and student, and between student and student, and these learning activities contribute to the development of the student's cognitive abilities and affect the student's attitude toward learning in a positive way (Vygotsky, 1987). In addition, the SCT discussed the teacher's role in teaching the curriculum in the classroom, which is as the mediator who stimulates the students' attention, directing and encouraging them to think, search and discuss their ideas in open discussion with one another (ibid). This teacher role regarding the SCT will contribute to developing the cognitive abilities of students and increase their motivation which will have a positive effect on students (How, 1996).

The argument above about the SCT and learning activities and the teacher's role in it may explain the findings of a negative attitude of students toward science and why they felt the science classes were boring and difficult to understand; this is because the learning activities and teacher role in teaching and learning the new science curriculum did not involve cooperative learning and social interaction in the classroom. This showed that the science teachers need some professional development programme with regard to learning activities and the SCT.

In addition, the findings from the teachers and students' interviews and questionnaires indicate that most science lessons are taught in the classroom and rarely in the science lab, as my observations confirm. I saw only two classes held in a science lab, although most students preferred to learn there. The findings also confirm that no science lessons were taught outside the school or even outside the classroom: going on field trips, visits to botanical gardens, science museums, science centres, etc., were unknown, even though, as the findings confirmed, most students would have enjoyed leaving the classroom and school to study science, feeling it to be helpful for their understanding. In their evidence most teachers and students indicated that they rarely went on scientific trips outside the school because the MoE was not interested in providing these options.

Teaching science outside the classroom will help the students to approach science more easily and to enjoy the lessons. This point is proposed in studies such as those by Braund & Reiss (2006), Cerini et al., (2003) and Reiss (2012): that learning outside the classroom on field trips is important; to visit, for example, the science museum, zoo and botanical gardens, because these trips help the students to connect their classroom learning with the world beyond and this helps them to better understand the science.

Comparing this study finding with those in previous studies, it is clear that it is important to diversify the teaching and learning activities including the social interaction and cooperative learning, because this helps the students to a better understanding of science and develops their cognitive abilities. In addition, given the problem that the teachers' wide use of traditional teaching methods is long-standing and continuous, despite the reform and development of the science curriculum, the reason for the monotonous and limited teaching methods may not be the new science curriculum, as the teachers assumed. A reason for teachers' reliance on old-fashioned teaching methods may be that the pedagogy studied by student teachers in their university period probably does not focus on changing this aspect, while the in-service teacher training lacks adequate training courses and professional development programmes in more varied teaching methods. This reveals the crucial role that training courses and development programmes might have on developing teaching skills. Unfortunately, as this study found, there is a lack of interest from the Ministry in providing such programmes; this finding will be discussed in more detail below.

### 7.10 Instructional tools in teaching and learning science

This section is related to the answers to Research Questions 1, 3 and 4 (RQ1, 3 and 4). Variety in the instructional tools makes classes interesting for the students (Kesidou & Roseman, 2002). However, the findings from the teachers' and students' interviews, questionnaires and classroom observations confirmed that most of the students do not believe that their teachers augment the range of educational tools used in lessons; they always depend on simple teaching tools, such as the whiteboard and overhead projector, despite the preference expressed by students for modern teaching tools and technology to be used. The importance of instructional tools is argued by the SCT which indicated that the instructional tools play a leading role in building knowledge, and enable students to use tools to solve difficult natural problems, or in other words, to use them as mediators (Vygotsky, 1987). Through the observations it has also been noted that only simple teaching tools are widely used, such as some graphics and images, and more advanced technological tools, such as videos and overhead projectors, are very rarely used. Regarding the use of such tools for teaching science, the findings from this study indicate that in Kuwait the teachers avoid such devices as iPads, iPhones, iPods, smart boards and computers, although most of the students were found to be experienced in their use and to prefer them.

Using iPads in education and teaching is recommended by some writers (Murray & Oclese, 2011; Petocz, 2011); they confirm that such new technological devices in education will impact positively on students' learning skills, because they permit collaboration between the students and make the experience of class and school more enjoyable. In addition, some studies stressed the need to use such tools in teaching (Harlen, 1999; Boohan, 2002; and Meurant, 2010). These studies confirm that to do so makes the lesson more easily absorbed and aids the development and improvement of the teaching process.

Furthermore, the findings from the teachers' interviews and questionnaires show that one of the reasons for the simplicity of the current instructional tools and the avoidance of new technology is that the MoE provides very few of them in relation to the science curriculum and, they added, was not interested in supplying them. This is consistent with some studies (Al-Balushi & Griffiths, 2013; Al-Momani, 2008; Haidar, 2000; Rugh, 2002) which illustrate the lack of the instructional teaching tools in many schools in Arab states included Kuwait and the lack of interest in providing them on the part of the MoE.

Most of the teachers' findings confirmed that the lack of suitable teaching tools is having a negative impact on the teaching of the new curriculum and on the students' attitude to learning science. This is backed up by the argument in a study by Braund & Reiss (2006) in which the authors state the importance of using instructional tools in teaching science, for instance virtual reality through simulations, because this helps to connect the students with what they are learning and will contribute to a better student attitude to science.

Another factor which hinders the teachers from using modern instructional tools, according to the findings, are the large number of students in each classroom, which of course has implications for classroom control.

This is in agreement with some studies (Ali, 2000; and Saad, 2001) which state that the number of students in the classroom in the State of Kuwait is often large. These studies also assert that the great number of students in a classroom will preclude the use of tools and more modern teaching methods, as well as hindering collaboration between students and classroom discussion.

When comparing the findings from the students' interviews and questionnaires in this study with some of the literature, it is clear that the lack of instructional teaching tools, the lack of variety in teaching methods and neglecting to use the new instructional tools are key factors in the boredom felt by the students in science classes. In turn, this negatively affects students' attitude to science and impacts on their understanding and learning; it also impacts negatively on teachers when they tackle the new science curriculum. This discussion goes into some of the factors which gave rise to the negative views of science teachers and students in this study.

### 7.11 Summary of the chapter

It is clear from the students' and teachers' questionnaires and interview findings that the teachers' views are not much different from the students'. The views of both teachers and students about the new science curriculum are generally negative and most of the teachers and students are not satisfied with it.

In brief, after revealing the study findings, discussing them and comparing them with the results of previous studies, it can be concluded that the negative views of most Kuwaiti students and science teachers about the new science curriculum and the reform process can be traced to such factors as the centralised working of the Ministry of Education. None of the teachers or students in Kuwait participated in the curriculum reform process nor in any decision-making process, because the Ministry of Education deals with teachers merely as implementers. It despatches ready-made teaching plans to the schools and ask teachers to follow these, and finally it controls the student assessment system.

In addition, other reasons for the negative views of teachers and students are the lack of relevance of the new science curriculum to the needs of Kuwaiti society and its culture, its religion and the students' abilities. As well as the problems of everyday life, society's needs, religion and culture are judged to be some of the most important issues to take into account when reforming or implementing new curricula, because otherwise students will not engage with them. The Kuwaiti students' and teachers' views regarding the new science curriculum were also obvious; the courses were designed in the USA, aimed at American teachers and students and translated from American textbooks, which did not correspond with, and indeed were far removed from, Kuwait's culture, religion and everyday needs.

Consequently, the way in which the educational processes of this curriculum in Kuwait still generally follows traditional ways without varying the teaching methods and tools shows a lack of imagination, as well as a failure to respond to the technological revolution in education which has opened up new ways of bringing technology into learning. This makes the teaching and learning of the new science curriculum more difficult and stands in the way of its success. In other words, students are not involved enough in the science lessons and the high class sizes limit or prevent active participation by the students.

The findings show that the defect is not only in the new science curriculum itself, but also in the reform process; the adaptation of the new science curriculum may have been inadequate. Thus, the new science curriculum has little relevance to the culture, religion and environment of Kuwaiti society and this influences the students and teachers, who feel that it does not relate to them. In addition, the introduction of the new science curriculum was made without any piloting, which would have provided an opportunity to discover the disadvantages and mistakes that must be avoided, thrown out or modified. Finally, the teachers were not prepared or supported by professional development training programmes relating to the new science curriculum.

All of these factors have contributed to the negative views of the teachers and students about the new curriculum, leading after discussion to a number of recommendations and suggestions for developing and reforming science education in Kuwait, starting with the curriculum, which are presented in the next chapter.

# Chapter 8

# Limitations, Implications, and Suggestions for Future Studies

## 8.1 Introduction

This final chapter of the thesis begins by considering the limitations of the research and goes on to offer some conclusions about the main findings and their significance for the reform of the science curriculum and its implementation from the perspective of the teachers and students. The implications of these research findings are then outlined, followed by suggestions for future research. Finally I add some general conclusions.

## 8.2 Limitations of the study

Like all other studies, this one has some limitations. Stating them in full does not minimise the relevance of the outcomes, and may supply a context in which to increase the validity and reliability of the research overall.

The main limitations I faced were a social product of the Arab Islamic culture of Kuwait, which does not permit mixing between men and women. I was constrained by them during the phase of data collection, when many female teachers refused to conduct interviews with men, and would not allow men as observers into their classes. I planned to give a balanced account of the reforms from the standpoint of both male and female teachers and spent much more time trying to arrange interviews with the female teachers than the male teachers, but sometimes failed. This is the reason why the number of female teachers represented in this study, in particular in the interviews and observations, is smaller than the number of male teachers.

The other limitation is associated with the research resources available in the context of Kuwait and the Arab states. I found it difficult to gain access to information references and resources on details of the reform of the science curriculum, science education and education system in Kuwait. There are very limited resources available on this topic and much evidence is missing. I found only a few official reports and some letters giving approval, so despite the time I spent in seeking access to more documentation of this kind, most of the information that I obtained came from newspapers. I faced the same difficulty also when I tried to find material relating to the reform and development of the science curriculum in other Arabic states.

The timeframe and scheduling for the interviews put other limitation on this study. I found it hard to schedule interviews for those who had instituted the reform, whose work always keeps them busy. I visited them many times at their offices at the Ministry of Education to arrange appointments for interviews. Sometimes I did not find them in their offices, and had no email address nor phone number for making contact with them. After repeated visits, I was able to interview only some of them.

Despite these limitations I think that this study can contribute to the knowledge of the socio-cultural perspectives on the reform and development of the science curriculum. I can make this assertion because I obtained questionnaire responses from many teachers and students and I chose the teachers and students to interview by using a strategy of maximum variation in the responses. Moreover I observed the science teaching and learning in four classrooms, noting the teaching methods, instructional tools, learning activities, students and role of the teacher.

### 8.3 The key findings and their significance

The study has showed significant findings with respect to the views of the science teachers, students and curriculum reformers about the process of reform and implementation of the science curriculum in the State of Kuwait. These findings are significant in that they point to factors and matters which are likely to have affected the reform process and the ultimate success of the curriculum implementation, such as the culture, religion, the needs of society, the views of teachers and students, students' abilities, centralism, teacher autonomy, the professional development of teachers and the instructional tools, which should all be taken into account when undertaking curriculum reform. These factors are discussed in the following paragraphs (and also see the quantitative and qualitative findings in Chapters Five and Six).

The degree of influence on the science curriculum reform of each of these factors was different, but from the data it appears that the socio-cultural context and religious beliefs had the most influence on the reaction to this new way of teaching and learning science and the next greatest influence was the centralised system of the MoE and teacher autonomy. These main factors are discussed in the next subsection.

### 8.3.1 The socio-cultural context

The findings from the teachers, students and reformers indicate the importance of taking into account the socio-cultural context of the science curriculum and the reform and development of science education. Although the curriculum reformers claim that they did their best to do so on this occasion, the findings from the teachers and students showed the majority view on their part that the new science curriculum had too little connection with the students' culture, which my analysis of the data revealed as influential on their attitude to learning science. In addition, the socio-cultural context affected the students' attitude to science lessons, because most of the students found the science lessons which were linked to their culture and daily lives were easier to understand than the others, as well as more enjoyable. They too thought that the effective ways of learning science were working with each other in groups or going on science trips out of school; both ways helped them to enjoy learning science and to understand it easily. The significance of these finding affects the usefulness of the reform and development of the science curriculum, since it concerns the socio-cultural perspectives of the intended beneficiaries.

### 8.3.2 Religious beliefs

In addition to the socio-cultural context, the findings showed that the teaching and learning of science are influenced by the religious beliefs of both teachers and students (see the qualitative findings and discussion in Chapters Six and Seven). In particular, most of the participating teachers did not have any experience of teaching aspects of science which conflicted with Islamic beliefs, such as cloning experiments and evolution theory, so they tended to be unwilling to teach them. In contrast, some teachers thought that teaching these issues was very important for the students and offered them the opportunity to debate and learn to discuss these controversial issues. However, most of the students could not accept lessons on such issues and found it hard to understand them. They indicated that they could easily understand the science lessons when they related to Quranic verses. Analysis of the data from teachers and students showed that they felt that the new science curriculum did not take into account the students’ and teachers’ religious beliefs. Yet the data from the reformers’ interviews indicated that they had adapted the science curriculum that they had chosen, so as to avoid conflict with Islam. This showed the difference between the findings from the two sides in this reform and takes us to the importance for the policy makers of involving the teachers and students and listening to their views early in the process of curriculum reform.

### 8.3.3 Centralism

The findings showed instead the centralism in the working system of the MoE, both in the process of the science curriculum reform and in the education system in general. The findings from the teachers, students and reformers indicated that this reform process had been planned by a group of science inspectors, some staff from the MoE and the assistant undersecretary. The teachers and students did not participate and were not consulted in any phase of the reform process and the findings showed that this omission had affected both teachers and students in their work. Most rejected a curriculum which had been implemented so suddenly and was unsuitable for the students' abilities. Most felt that the content was hard to grasp. This was reflected in the views of the teacher participants, who felt frustrated by being ignored in the educational decision and by the general lack of interest in their views on the part of the MoE; this had a negative impact on their teaching. The significance of these findings shows the importance of involving teachers in educational decisions, since they are part of the education system. It is also important to listen to students’ views when planning a curricular development.

### 8.3.4 Teacher autonomy

In addition, the findings showed a lack of teacher autonomy. In Kuwait the teacher’s role is limited to complying with the MoE decisions and orders, even down to teaching plans and the times and modes of student assessment. This means that teachers are given no freedom in teaching. The findings showed that the lack of teacher autonomy in science lessons has influenced the teachers’ performance, which it hinders from being creative and is bound to have a negative influence on the students’ attitude to the subject. Predictably, then, most of the students showed that they thought science boring, difficult to grasp, unappealing and unattractive as a future career. The significance of this finding is in showing the contribution made by creative teaching to the study of the subject and the fostering of future scientists.

Regarding the teacher’s role, the findings showed that teachers face some constraints, such as a lack of instructional tools, overfull classes; lack of time, lack of professional development and too heavy a workload, all of which influenced their performance. The finding provided evidence that these constraints adversely affected the teaching: for example when they faced any of them they chose to alter their teaching practice rather than use coping strategies to overcome or minimise the impact of the constraint. This may have explained why most of the teachers used traditional methods in teaching science and devised no new methods; it may also explain why they tended not to involve the students in the practical experiments. This may also go some way to explaining the negative views of the students and their attitude to science.

The findings showed that the interaction between these constraints increased their cumulative influence in the classroom. For example, the lack of instructional tools was related to large class sizes, which in turn influenced the time available for teaching and learning. In addition, the lack of professional development and heavy administrative workload influenced the creativeness of the teachers and their attitude to teaching science. All these constraints acted to encourage the teaching of science in traditional ways and led the science classes to be less interesting for the students. Over time, these constraints and the teacher’s reactions to them might evolve into a set of beliefs which will gradually cohere into a personal philosophy of teaching that will be difficult to change.

### 8.4 Implications of the study

This study identified a variety of significant implications for science education regarding the development of the new curriculum, science teachers’ education and the students’ attitude to science. It is suggested that the implications of this study are that teachers and students need to be engaged as participants in the process of developing and reforming the science curriculum and other areas of science education. These implications include the following:

### 8.4.1 Implications for decision makers

In terms of the decision makers in the curriculum reform, their role carried the potential for improving science education in many ways, including the following:

- The findings of the study illustrate that there is a gap between the decision-makers in the Ministry of Education, on the one hand, and teachers and students, on the other. The findings indicate a centralised system of working by the Ministry of Education, which took all the related educational decisions, leaving the teacher with nothing but the duty of implementing other people's decisions without taking part in them. Not involving, or even consulting the teachers in educational decisions may negatively affect teachers' performance and be reflected in the students' attitude to learning (Dillon, 2009), and in Kuwait's case appears to have done so. The decision-makers, when they approach educational decisions, should consider the teachers' and students' views.

- Regarding the reform process of the science curriculum, the findings showed that the teachers and students played no part in this process, and nobody listened to their views soon enough. In the same way, they were surprised by the imposition of the new science curriculum without preparation. The non-participation of teachers in the reform process has had a negative effect on the attitudes of both teachers and students in teaching and learning science, and they have experienced difficulty in the teaching and studying of these curricula, which has created a sense of dissatisfaction with the subject. This evidence is supported by Wordburg & Gress-Newsom (2002), who assert the importance of involving teachers in the curriculum reform process and the need to listen to their opinions, suggestions and worries over the difficulties that they may face, because doing so will contribute to the success of the curriculum development process. Ryder (2014) indicates that science curriculum reform rarely reflects the intended outcomes of the curriculum designers and developers, and the result is that many teachers who did not proactively choose to adopt a curriculum reform initiative do not carry out the curriculum reform as intended by its developers. He concludes that curriculum reform should not be seen to downplay the central role of the individual teacher (Ryder, 2014).

The decision-makers should take into account the views of the teachers and involve them in the reform process. It is also necessary to create a network of cooperation between the decision-makers in the Ministry of Education and the teachers in schools.

- The findings showed that the Ministry of Education in Kuwait failed to listen to the students' voices in general and in the process of the science curriculum reform in particular, to discover what they thought they needed and what their views were regarding science lessons. This is brought out by Manefield et al (2007), who indicate that listening to such voices contributes to success in the curriculum development and reform process. Indifference to what students need from science teaching may have repercussions for the students' attitude to science: the findings showed that most of them view the subject negatively and describe its classes as boring. In addition, most of the students preferred to study elements of science which they could use in everyday life, but the current curriculum gives them little of this. In this respect, Reiss (2006) argues that it is important to listen to students so as to understand their needs and preferences in studying science, because relating the science to their needs contributes to their successful learning. The decision-makers should listen to what the students say and take their views, needs and preferences into account when they reform and develop the science curriculum.

- The study showed that the teachers faced some constraints which impact on their performance in teaching the science curriculum. These constraints are mainly a lack of modern instructional tools and technology, including smart boards, computers, projectors, and other modern technological tools, large class sizes and a heavy administrative workload. In addition, the findings showed that the teachers need good working conditions to implement the science curriculum successfully, because these offer the only way to foster an environment that produces good teaching and learning conditions (Mansour, 2008). Therefore, the policy makers should solve the problems which teachers face; they should provide suitable school conditions and the latest teaching and technological tools for teaching science, because this will contribute to making the school a desirable and enjoyable place for the teachers and students, and will also play a major role in the easy absorption and smooth understanding of the lessons (Boohan, 2002; and Harlen 1999).

- The findings showed there is a lack of professional development programmes for teachers, which creates a state of dissatisfaction among them and also impairs their performance and hence that of students, if they cannot understand the lessons. This is endorsed by Dagher & BouJaoude (2011), who believe that professional development programmes for teachers will contribute to improving the performance of the science teachers and develop teaching skills, which in turn will be reflected positively in the students and their understanding of the science classes, as well as their desire to study science and apply it in everyday life. Decision-makers around the world need to pay attention to developing the skills of teachers in the education process by providing a number of professional development programmes for them so as to improve their performance in the classroom.

### 8.4.2 Implications for science teachers

In terms of the science teachers, the focus on their views in this study carried the potential for improving teacher education in many ways, including the following:

- The study showed a lack of teacher autonomy in Kuwaiti schools, where the science teachers' role is limited to teaching a defined curriculum and preparing the students to pass an imposed exam. This hampers the teachers' creativity. The teacher has no freedom in choosing what to teach or changing the teaching plan, or in assessing the students, with the effect that most are dissatisfied by their work. Davis (2003) argues that a lack of teacher autonomy will impact negatively on the teaching of science and in turn on the students' learning. Teachers must be given enough freedom in teaching the science curriculum and assessing the students and must be allowed to exercise creativity and work towards excellence in the teaching process. No constraining rigid teaching plan, which must never be modified, should be imposed upon teachers, because this limits their creativity.

- The study showed that most teachers are dissatisfied with or do not accept the new science curriculum, not only because it is inferior in itself but because they did not contribute or participate in the curriculum reform process and they do not feel that they should take responsibility for any changes. Teachers do not passively accept innovative ideas as soon as they are informed about them, unless they are convinced of their effectiveness (Mansour, 2008). This may be the reason for the teachers' currently negative attitude to teaching science, which they mostly felt was difficult under the new curriculum. The process of curriculum reform is likely to fail if the teachers do not share in the decisions, because the teachers will not accept them easily (Dillon, 2009). Therefore, science educators should be aware of science teachers' views and needs when they reform and develop the science curriculum.

- The study showed that most science teachers may not have an adequate understanding of the nature of science and its socio-cultural context and in practice not enough teachers have experience of dealing with the relationship between teaching science and the socio-cultural context. Teaching science which takes account of the socio-cultural context helps students to understand the science easily and makes the science class enjoyable (Lemke, 2001). To provide this, teachers should be trained to deal with ways of teaching science that are suited to its context.

- The study showed that most science teachers cannot deal adequately with the relationship between science and religion. The study also indicates that for most teachers, their religious experience of teaching controversial issues was only in informal situations (the family, the social milieu, the media, etc.) and they would rather not or are not prepared to teach scientific topics which conflict with the Islamic religion. In addition, science teachers' personal religious beliefs are a highly potent variable which can have a positive or negative influence on the entire teaching science process. In this respect, Reiss (2010) argues that science teachers need and should receive more continued professional development in dealing with reconciling science with religious beliefs.

### 8.4.3 Implications for curriculum development in science

In terms of curriculum development in science, the implications can be summarised by the following points:

- The findings of the study indicate that the new science curriculum is not related to the socio-cultural expectations of the Kuwaiti student; indeed, some teachers indicated that the new science curriculum reflected a Western culture rather than an Arab culture. They felt that the new science curriculum was focused on the development of science by Western scientists and might have a negative effect on students' identities and their attitude to learning science or their continued study of the subject. In this respect, Aydarova (2012) indicates that the Western science curriculum must be adapted carefully before it is implemented in the schools of the Gulf States so that it relates to the students' culture. Curriculum reformers should think about 'Multicultural science', within which pupils can be helped to see that science is a cultural activity and it is inevitably the case that different cultures produce different sciences (Reiss 2000, p.18). Reiss (1993a) argues that science education should be universal and should encourage students to wonder about the natural world and shape their own scientific thinking. This implies that both socio-cultural and multicultural perspectives should be taken into account when reforming the science curriculum.
- The findings showed that religious beliefs are hardly ever brought in to the teachers' and students' discourse in teaching and learning science. The students prefer to relate the science lessons to verses from the Holy Qur'an or sayings of the Prophet and they feel that doing so helps them to understand science more easily. Endorsing this, Reiss (2010) says: ''Teaching about aspects of religion in science classes could potentially help students to better understand the strengths and limitations of the ways in which science is undertaken, the nature of truth claims in science and the importance of social contexts for science. In that sense, considering religion within science

education places the issue squarely within the consideration of mainstream socio-scientific issues'' (p. 97).

In addition, the teachers and students indicated that if there is some scientific knowledge which may conflict with Islamic belief, they would rather not learn and teach it. In this respect, El-Baz (2009) argues that, even so, scientific knowledge which may conflict with Islamic belief has still to be taught and discussed in light of Islamic belief, because this will encourage the students to search for the truth, which will contribute to developing their thinking skills and powers of investigation. Such conflicts would act as formal pathways to knowledge about developing the science curriculum so as to tackle the relationship between science and religion, and would also train teachers how to debate issues related to science and religion.

- The findings also showed the negative impact on the students' attitudes to science. They felt that the science lessons were boring, not enjoyable, not able to develop their skills and not able to encourage them to research and explore. This may be why they wished they need not continue them in high school and did not plan to become scientists. This line is taken by Hidar (2000), who maintains that the science curriculum needs to develop to encourage students to continue studying it in future and becoming scientists, because new science graduates are needed to develop the state scientifically, economically and technologically. This is another pathway for developing the science curriculum; it should encourage students to become scientists.
- In the findings of this study, it has been shown that the introduction of curriculum reform came very late, after more than 13 years. The old science curriculum was taught from 1995 without any changes, despite the many developments in science, technology, economics and social studies. This may be reflected in the teachers' and students' attitudes to teaching and learning science. Equally, it may partly explain the negative reaction of teachers to the curriculum reform process, because the new curriculum was a complete change, after so many years of stagnation, and was imposed overnight. Ryder & Banner (2011), in contrast, think it necessary to develop, reform, and review the science curriculum on an ongoing basis to keep it updated and in step with

scientific, technological, economic and social developments. These developments and discoveries are made continuously; therefore, specialists and decision-makers should develop a comprehensive long-term plan for improvement and reform, so that the process of education reform, including the development of the science curriculum, will be such an ongoing process that students will benefit from it. It will create more of an interest in studying science; the students will feel that whatever they learn is reviewable and linked to scientific and technological developments around the world.

- The findings showed that most teachers have difficulty in teaching the current curriculum content within the scheduled periods, while the students cannot absorb so much theoretical information in each science lesson and misses the practical lessons which most of them prefer. Among the implications of this study is also the need to minimise the content of the curriculum and focus on the quality and depth of learning, as well as giving more attention to such practical aspects as the conducting of scientific experiments and encouragement of students to share the experimental process, because this enhances their understanding of the lessons and encourages them to learn cooperatively, to enjoy science lessons and to explore. This is confirmed by the socio-cultural theory which is used as the theoretical framework in this study. It holds that cognitive development depends on the Zone of Proximal Development (ZPD) and the level of development depends on children's engagement in social behaviour. In addition, cognitive development needs social interaction and the skill with which accomplished adult guidance or peer collaboration exceeds what can be accomplished alone (Vygotsky, 1987).
- The findings of this study showed that the current assessment system has negative effects on the students' aims in learning science: for most of them it had become passing the examination to rise to the next academic stage. Most of the science examinations in the Arabic-speaking states depend on memorizing information more than understanding it, and this information will be forgotten in the course of time, as some studies confirm (BouJaoude & Gholam, 2013). Therefore, an assessment system should be developed in order to prevent examination pressure to move to the next academic stage from

being the sole reason for studying. Moreover, there should be several methods of assessment, taking into account the levels and decisions of the students, and the individual differences between them, because this would contribute to a change for the better in the attitude of the students to science.

### 8.5 Suggestions for further research

After having discussed the results of this study and their implications, and the most important recommendations, I would like to make some suggestions for further studies. They should take account of:

The need for a deeper understanding of the way in which these teachers' and students' religious beliefs positively and negatively affect the teaching and learning of science. The findings of this study have highlighted the influence of the teachers' and students' religious beliefs and experiences in teaching and learning science. This influence could be explored through a research approach which gauges the effect of religious beliefs on the teaching and learning of science and the relationship of the two.

The findings of the research also indicate that the life experiences and socio-cultural expectations of teachers and students play a major part in the formation of their beliefs, and also influence their practices in teaching and learning science. The effects of teachers' and students' socio-cultural experiences need more studies in depth to explore how they operate and how they are reflected in the study of science.

The current study has focused on science curriculum in the 6$^{th}$ and 7$^{th}$ grades of the intermediate school. It would be useful to carry out a study on the science curriculum in other educational stages, such as primary, other phases in the intermediate stage (the 8$^{th}$ and 9$^{th}$ grades) and in the secondary school, to obtain a comprehensive view of the science curriculum reform process.

The findings of this study have highlighted that the students' experiences are influenced by their communities, notably their families, so another proposal is to conduct a study in which the views of the parents of students are considered in order to discover what they think and suggest, with respect to the science curricula, and the problems they face with their children's science education.

The findings showed that the current science curriculum is imported from the USA which has a different educational system, so a comparative study could be conducted between science education in the State of Kuwait, on the one hand, and science education in the USA or another Western country, on the other, to identify the strengths and positive points in Western science education and its science curricula, in order to benefit the parallel developments in Kuwait. This future study will help also to understand the best way to adapt a Western science curriculum for adoption in another country such as an Arabic state.

Among the proposed studies is also one on the new science curriculum, which would involve the largest possible number of teachers and students, through questionnaires, interviews and observations, in order to identify the views of a much larger number of teachers and students than the present one.

This study highlighted that teachers have different views on science, according to their experience, specialism and gender. These differences could be investigated in depth by a future researcher. The study could investigate different views and attitudes to teaching science among teachers with regard to their gender, experience, specialism and qualifications and explore in depth the reasons for these differences.

In addition, this study dealt mainly with in-service science teachers' views and practices. However, the findings of the study highlighted how previous personal experiences were associated with different views, according to whether the teachers qualified by means of a science education course or a pure science course. Thus there is a need to identify the views brought by pre-service science teachers to their teacher education programme of teaching and their role as teachers. Future research on the educational views of pre-service science teachers may help to reveal how they interpret and define the goals and curricula of a teacher education programme from religious perspectives.

The SCT are used as theoretical framework in this study and it will be better to use other theory such as Activity theory to investigate the relationship between two activity system which are the first activity system is the science curriculum reform by the Ministry of Education, and the second activity system is the school which are implemented the new science curriculum in the classroom. Using activity theory in will be helpful for investigating the relationship between the two different activity systems and will help in understanding and nature of the relationship between these activity systems and how it influences in teaching and learning the new science curriculum.

Finally, the findings of this study highlighted that there are different views between students of different gender, so these differences could also be explored in greater depth. Future researchers are recommended to investigate the different views of the students and their attitudes to science on the basis of gender and explore in depth the reasons for these differences.

### 8.6 Final words

I hope that this study will contribute to the reform and development of science education and curricula in the State of Kuwait, as well as the solution of such problems as are faced by both teachers and students in science lessons. I hope that this study will be used in the development of education and science curricula as a reference and source, and would wish that this study was advantageous not only to the researchers and the decision-makers in the State of Kuwait, but possibly to all those who are interested in the field of science education and curriculum in all parts of the world, and that the results of this study could be used as a reference for further studies in the future.

I have gained great benefit from my PhD studies at the University of Exeter; I have learned and read a great deal about science curricula and education and how to develop and reform them. I will do my best in the future to convey whatever I have learned to the State of Kuwait through seminars and courses on education and the best methods of developing and reforming the science curriculum, as well as through my work at the University's College of Education for the teachers and students who will become the teachers of the future. I will also exert my best efforts to prepare the new Kuwaiti teachers for moving to the schools and starting to teach their own students.

Finally, I want to continue self-education, research, reading and self-development, and to serve the nation and the world through the dissemination of scientific research and results which contribute to the development of education around the world.

# References


Abd-El-Khalick, F., BouJaoude, S., Duschl, R. A., Hofstein, A., Lederman, N. G., Mamlok-Naaman, R.,Niaz, M, Treagust, D. & Tuan, H-L. (2004). Inquiry in Science Education: International Perspectives. *Science Education 88* (3), 397-419.

Aikenhead, G. (1997). Student views on the influence of culture on science. *International Journal of Science Education*, *19* (4), 419-428.

Aikenhead, G. (2001). Integrating Western and Aboriginal Sciences: Cross-Cultural Science Teaching, *Research in Science Education Journal*, *31*(3), 337-355.

Aikenhead, G. (2008). Importation of Science Programs from Euro-American Countries into Asian Countries and Regions: A Recipe for Colonization? A keynote paper represented to the Conference of Asian Science Education 2008, Kao-hsiung, Taiwan, February 20-23, 2008.

Aikenhead, G. S., & Jegede, O. J. (1999). Cross-cultural science education: A cognitive explanation of a cultural phenomenon. *Journal of Research in Science Teaching*, *36* (3), 269-287.

Ahn, K. (2009). Learning to Teach Within the Curricular Reform Context: A Sociocultural Perspective on English Students Teachers’ Practicum Experience in South Korea. PhD thesis, Pennsylvania State University, 1-284.

Alaan newspaper (2013). The Kuwait students' sit-in behind the Ministry of Education in Kuwait. http://www.alaan.cc/pagedetails.asp?nid=158165&cid=53. [Accessed 16 December 2013].

Al Balushi, S., & Griffiths, D. (2013). The School Education System in the Sultanate of Oman. In Donn, G., & Almanther, Y. (2013). *Education in the broader Middle East: borrowing a baroque arsenal*. Symposium books.

Al-Abdulghafoor, F. (1983). The development of education in Kuwait 1912-1972. MA thesis, University of Kuwait.

Al-Ahmad, A. (1999). *Teaching and learning skills in the classroom.* Kuwait: Alfalah

Al-Barak, B. (2011). The curriculum and education in Kuwait. The report of the Second Education Forum for the Women's Cultural Society. Kuwait.

Al-Daami, K., & Wallace, G., (2007) Curriculum Reform in Global Context: a Study of Teachers in Jordan. *Curriculum Studies, 39* (3), 339–360.

Al-Demerdash, S. (2013). *Islamic Religion and the Science*. Alrai Publisher. Kuwait.

Al-Enezy, T. (2008). The education system and teacher role in Kuwait. MA dissertation. Aman University. [In Arabic].

Alexander, D. R. (2007). Models for relating science and religion. *Faraday paper*, 3, 1-4.

Alexander, R.J. (2001).*Culture and Pedagogy: international comparisons in primary education*. Oxford: Blackwell.

Alexopoulou, E & Driver, R (1996). Small-Group Discussion in Physics: Peer Interaction Modes in Pair and Four, *Journal of Research in Science Teaching, 33* (10), 1099-1114.

Al-Ghamdi & Al-Salouli (2013). Saudi elementary school science teachers' beliefs: Teaching science in the new millennium. *International Journal of Science and Mathematics Education 11* (2) 501-525

Alhajeri, S. (2007). The extent of communication skills among school principals in the state of Kuwait. MA dissertation. Kuwait University. [In Arabic].

Al-Hamad, R. (2004). *Let's Listen to Teachers Voices.* The 33rd Teachers' Society conference. March 14-17, 2004. Kuwait.

Ali, R. (2000). Evaluation of science curriculum in stage seven in Kuwait. *Journal of teaching science.* 12 (21), 42- 64. [In Arabic].

Al-Khatrash, F., (1984). *The history of the relations of Britain and Kuwait*. Alsalasel Publisher. Kuwait. [In Arabic].

Al-Khayat, R. (2012). The TIMSS test results of the Kuwaiti students. The National Center for Developing Education in Kuwait.

Al-Loghany, M. (2011). Developments in education curriculum. The 40th Teachers Society Conference, March 20 – 23, 2011 in Kuwait.

Al-Momani, I., Ihmeideh, F., & Momani, M. (2008). Teacher view of the effectiveness of the United Arab Emirates Kindergarten Curriculum, Instructional strategies and assessment procedures. *Journal of Research in Childhood Education. 23* (2), 239-252.

Alqasemy, K. (2013, February 10). Reforming the science curriculum in UAE. *Emaratalyoum Newspaper*. http://www.emaratalyoum.com/local-section/education/2013-02-10-1.548461. [Accessed 13 April 2013].

Al-Quhtany, A. (1999). Student abilities to learning science in Kuwait. *Education Journal*. *14* (2). 68- 93. [In Arabic].

Al-Rabeah, K. (2004). *The Education Inspectors: These are our ideas for development, modernisation and reform of the education system in Kuwait.* Alwatan Publisher. Kuwait.

Al-Rashed, S. (2000). Developing science education in Kuwait. (Unpublished master dissertation). Aman University. [In Arabic].

Al-Sebeh, M. (2009). Professional development for the teacher. The 38th Teacher Society Conference. March 22-24 2009. Kuwait.

Al-Saleh, M. (2007). *Human and life: in steps with the Qur'an verses*. Obeikan Library. Riyadh.

Alshammari, A. (2008). An Investigation of the extent of Co-operative teaching in science teaching in the state of Kuwait and of teachers' attitudes to co-operative learning. Master's Dissertation, Glasgow: Strathclyde University.

Al-Shaiji,N. (2011). Arabic Language curriculum in stage one and two: case of Kuwait. Study Published by: Al-Qabas newspaper. Kuwait.

Al-Shatti, Y. (2012). The new science and mathematics curriculum: new predicament of education. Al- Qabas newspaper. Kuwait.

Al-Shaya, F., Abdulhameed (September, 2011). Mathematics and Science Curriculum Development Project in the Kingdom of Saudi Arabia – Expectations and Challenges. Paper presented at the 15th Scientific Conference on 'Scientific Education: New Thoughts for a New Reality', which was held in Egypt. pp. 113-128.

Al-Wetaid, M. (2008). *The aim of the science curriculum reform. The introduction of the Science textbooks in Kuwait.*

Al-Wetaid, M. (2011). The education development in Kuwait. The 40th Teachers society conference. March 20 – 23, 2011 in Kuwait.

Al-Yosufy, A. (2000*). Iraqi Invasion of Kuwait*. Alfalah publisher. Kuwait. [In Arabic].

American Association for the Advancement of Science (AAAS). (1994). *Benchmarks for science literacy*. New York: Oxford University Press.

American Association for the Advancement of Science (AAAS). (2000). *Designs for science literacy*. New York: Oxford University Press.

Anderson, L. & Krathwohl, W. (2001). *A taxonomy for learning, teaching, and assessing. A revision of Bloom's taxonomy of education objectives*. New York: Longman.

Arab Bureau of Education for the Gulf States, The. (2010). *Efforts of the Arab Bureau of Education for the Gulf States in the unification of curriculum and development: Documentary study*. Kuwait.

Archbald, D. A. & Porter, A. C. (1994) Curriculum Control and Teachers' Perceptions of Autonomy and Satisfaction. *Educational Evaluation and Policy Analysis* 16 (1), 29-39.

Attride-Stirling, J. (2001). Thematic networks: an analytic tool for qualitative research. *Qualitative Research, 1*(3), 385-405.

Aydarova, O. (2012). If Not 'the Best of the West,' then 'Look East': Imported Teacher Education Curricula in the Arabian Gulf. *Journal of Studies in International Education, 17*(3), 284–302.

Ayres, P., McCormick, J. & Beechey, B. (2002). Teachers' Perceptions of the Implementation of the New NSW Higher School Certificate. Paper presented at the Australian Association for Research in Education in Annual Conference. Brisbane 2nd December 2002.

Azmy, A. (2006). The effectiveness of instruction according to Vygotsky's theory in the acquisition of some environmental concepts among Al Aqsa university female students. Master dissertation. Islamic University in Gazah.

Badran, A. (1993). The status of science teaching in the Gulf countries. In M. Debs (Ed.), *Proceedings of the first scientific conference on the future of science and mathematics teaching and the needs of Arab society,* Tunisia, 19–22 December [In Arabic] (pp. 154–172). Beirut, Lebanon: Arab Development Institute.

Baker, D., & Taylor, P.C.S. (1995). The Effect of Culture on the Learning of Science in Non-western Countries: The Results of an Integrated Research Review. *International Journal of Science Education, 17,* 695-704.

Ball, I., Jones, R., Pomeranz, K., & Symington, D. (1995). Collaboration between industry, higher education, and school systems in teacher professional development. *International Journal of Science Education, 17,* 17-25.

Balnaves, M. & Caputi, P. (2001). *Introduction to quantitative research methods: an investigative approach*. London: Sage.

Baptiste, I. (2001). Qualitative data analysis: Common phases, strategic differences. *Forum Qualitative Sozialforschung/Forum: Qualitative Social Research Journal, 2* (3).

Barab, S. A., & Luehmann, A. L. (2003). Building sustainable science curriculum: Acknowledging and accommodating local adaptation. *Science Education*, *87*(4), 454–467.

Barani, G., Azma, F., & Seyyedrezai, S. H. (2011). Quality indicators of hidden curriculum in centers of higher education. *Procedia Social and Behavioral Sciences*, 30, 1657–1661.

Barbour, I. G. (1990). *Religion in an Age of Science: The Gifford Lectures 1989-1991*, Vol 1. SCM, London, UK.

Bashshur, M. (2009). Curriculum in Arab states: Historical and contemporary perspectives. In S. BouJaoude & Z. R. Dagher (Eds.), *The World of Science Education: Arab states* (pp. 11–25). Rotterdam, Netherlands: Sense Publishers.

Battista, M. (1994). Teacher beliefs and the reform movement in mathematics education. Phi Delta Kappan, 75(Feb), 462-63.

Beauchamp, G. A. (1982). Curriculum Theory: Meaning, Development and Use. *Theory Into Practice*, *21* (1), 23-27.

Becker, H. S. (1996). The epistemology of qualitative research. *Ethnography and human development: Context and meaning in social inquiry*, 53-71.

Bell, J. (2010). *Doing Your Research Project: A guide for first time researchers in education, health and social science. 5th Edition*. Maidenhead: OU Press.

Berliner, D.C.(2002). Educational Research: The Hardest Science of All. Educational *Researcher, 31*(8), 18-20.

Billingsley, B. (2013). Students' Perceptions of Apparent Contradictions between Science and Religion: Creation is Only the Beginning. In Mansour, N. & Wegerif, R. (Eds). *Science Education for Diversity in the Knowledge Society: Theory and Practice*, (pp. 328-338). New York: Springer.

Blaikie, N. (2000). *Designing Social Research*. Cambridge. Polity Press.

Blair, T. (2009) Report on Vision of Kuwait by the year 2030. Copy available in Al-Qabas (2009). http://www.alqabas.com.kw/Article.aspx?id=535761&date= 27092009 . [Accessed on: 15.10.2011].

Bliss, J (1995). Piaget and After: The Case of Learning Science, *Studies in Science Education,* 25, 139- 172.

Bodrova, E. & Leong, D. (1998). Scaffolding Emergent Writing in the Zone of Proximal Development. *Literacy Teaching and Learning. Vol. 3* (2), 1-18.

Boohan, R. (2002). ICT and Communication, in S. Amosand R. Boohan (eds). *Aspects of Teaching Secondary Science: Perspectives on Practice.* London: Routledge Falmer

BouJaoude, S. (2010*).* 'Competencies and Educational Structures Needed to Prepare Secondary Students for the 21st Century'. Paper presented at a symposium organized by the Ministry of Education in the United Arab Emirates in cooperation with the Arab Bureau of Education for the Gulf States. February 24, 2010.

BouJaoude, S., & Gholam, G. (2013). Gender and science in the Arab states: current status and future prospects. In Mansour, N. & Wegerif, R. (Eds). *Science Education for Diversity in the Knowledge Society: Theory and Practice*, (pp. 339-358). New York: Springer.

Bramall, S. and White, J. (2000) *Will the New National Curriculum Live Up to its Aims?* (Impact policy discussion document No.6). Ringwood: Philosophy of Education Society of Great Britain.

Braun, V. & Clarke, V. (2006). Using thematic analysis in psychology: Qualitative Research in Psychology. *System*. *3* (2), 77-101.

Braund, M. & Reiss, M. (2006) Validity and worth in the science curriculum: learning school science outside the laboratory. *Curriculum Journal*, 17, 213-228.

Bryman, A. & Cramer, D. (2005) *Quantitative data analysis with SPSS 12 and 13, A guide for social scientists.* London, Routledge.

Bullough, R. V., Jr., & Baughman, K. (1997). *First-year teachers eight years later: an inquiry into teacher development.* New York: Teachers College Press.

Cerini, B., Murray, I. and Reiss, M. J. (2003). *Student Review of the Science Curriculum: Major Findings*. London: Planet Science.

Constitution of the State of Kuwait, (1962).

Chaiklin, S. (2003). The Zone of Proximal Development in Vygotsky's Analysis of Learning and Instruction. In Kozulin, A., Gindis, B., Ageyev, V. & Miller, S. (Eds.). *Vygotsky's Educational Theory and Practice in Cultural Context.* Cambridge: Cambridge University Press.

Charmaz, K. (2000). Grounded theory: Objectivist and constructivist methods. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research (*2nd Edn); pp. 509-535. Thousand Oaks, CA: Sage.

Charmaz, K. (2001).Grounded theory. In: Emerson, R.M. (ed.), *Contemporary field research: Perspectives and formulations*, pp. 335-352. Prospect Heights, IL: Waveland Press.

Cohen, L. Manion, L. & Morrison, K. (2011). *Research Methods in Education. (7th Edn.*). London: Routledge.

Corbett, K., Gardner, C., Taffaro Jr., & Nelson, M. (2013). Piloting a New Curriculum: A View from the Trenches. Proceedings of the American Society of Engineering Education Annual Conference and Exposition. June 23-26, 2013. Atlanta, Georgia.

Corder. G, & Foreman, D. (2009). Nonparametric Statistics for Non-Statisticians. A step-by-step approach. Published by John Wiley & Sons, Inc.. Hoboken, New Jersey.

Crawford, K. (1998). The Construction of the National Curriculum: An Ideological and Political Analysis. *Research Papers in Education*, *13* (3), 261–276.

Creswell, J. (2012). *Educational Research, Planning, Conducting and evaluating quantitative and qualitative, (4th Edn)*. United States of America: Person.

Crotty, M. (2003). *The foundations of social research.* London. Sage.

Dagher, Z. R. (2009). Epistemology of science in curriculum standards of four Arab countries. *The world of science education: Arab states*, 41-60.

Dagher, Z. R., & BouJaoude, S. (2011). Science education in Arab states: Bright future or status quo? *Studies in Science Education*, *47*(1), 73-101.

Davis, K.S. (2003). 'Change is hard': What science teachers are telling us about reform and teacher learning of innovative practices. *Science Education, 87* (1), 3-30.

Denscombe, M. (2010). *The good research guide: For small-scale social research (4th edn.).* Buckingham: Open University Press.

Devetak, I., Glazar, S. & Vogrinc, J. (2010). The Role of Qualitative Research in Science Education. *Eurasia Journal of Mathematics, Science & Technology Education*, 6 (1), 77-84.

Dillon, J., (2009). 'On Scientific Literacy and Curriculum Reform', *International Journal of Environmental & Science Education*. 4 (3), 201–213.

Dinov, I., Christou, N, and Sanchez, J. (2008 ). Central Limit Theorem: New SOCR Applet and Demonstration Activity. *Journal of Statistics Education*. *6* (2), 1-15.

Donn, G., & Almanther, Y. (2013). *Education in the Broader Middle East: borrowing a baroque arsenal.* Symposium books.

Donnelly, J. & Ryder, J. (2011). The Pursuit of Humanity: Curriculum Change in English School Science. *History of Education*, *40* (3), 291–313.

Doolittle, P.E. (1997). Vygotsky's Zone of Proximal Development as a theoretical foundation for cooperative learning, *Journal on Excellence in College Teaching*, *8* (1), 83-103.

Duranczyk, I., Loch, S., & Stottlemyer, J. (2013, May 13). Central Limit Theorem: Assumptions and Conditions. Retrieved from the OpenStax_CNX Web site: http://cnx.org/content/m46217/1.1/.

Eash, M. (1991). Curriculum components. In A. Lewy (Ed.), *The international encyclopedia of curriculum* (pp. 71-73). Oxford, UK: Pergamon Press.

Education Statistical Group (2012). Ministry of Education in Kuwait.

*Education Strategy Project for Kuwait before 2025, The*. Published (2001) by the Supreme Council for Planning in Kuwait.

Edwards, A. & Daniels, H. (Eds) (2004) Using sociocultural and activity theory in educational research. *Educational Review*, 56 (2), 107-111.

Elbaz-Luwisch, F. (2006). 'Studying teachers' lives and experiences: Narrative inquiry in K-12 teaching', in D.J Clandinin (ed) *Handbook of narrative inquiry*, California, Sage.

El-Baz, F. (2009). Reform in Arab Countries: The Role of Education. *The Journal of Education 188* (3). 41- 49.

Engeström, Y. (2001). Expansive Learning at Work: toward an activity theoretical reconceptualization. *Journal of Education and Work*, 14, 133-156.

Erickson, F. & Schultz, J. (1992). Students' experience of the curriculum. In P. Jackson (ed), *Handbook of Research on Curriculum* (pp. 465–485). New York: Macmillan.

Ernest, P. (1994). *An Introduction to Research Methodology and Paradigms*. Educational Research Monograph series. School of Education, University of Exeter.

Ezzy, D. (2002). Qualitative analysis: Practice and innovation. New Fetter Lane, London: Routledge, Taylor & Francis Group.

Fahad, H. (2002). Encouraging the students to learn science: easy or difficult? *Cooperative Journal, 16* (1). 51-72. [In Arabic].

Faruqi, Y. M. (2006). Contributions of Islamic scholars to the scientific enterprise. *International Education Journal, 7*(4), 391-399.

Fernandez, T., Ritchie, G., & Barker, M. (2008). A sociocultural analysis of mandated curriculum change: the implementation of a new senior physics curriculum in New Zealand schools. *Journal of Curriculum Studies, 40*(2), 187-213

Ferreira, C., Baptista, M., & Arroio, A. (2013). Teachers' pedagogical strategies for integrating multimedia tools in science teaching. *Journal of Baltic Science Education*, *12* (4), 509-524.

Fontana, A., and Frey, J.H. (1994). Interviewing: The art of science. In *Handbook of Qualitative Research.* Edited by Denzin, N., and Lincoln, Y. London, U.K: Sage Publications.

Fortus, D., Dershimer, R.C., Krajcik, J.S., Marx, R.W., & Mamlok-Naaman, R. (2004). Design-Based Science and Student Learning. *Journal of Research in Science Teaching, 41* (10), 1081–1110.

Fullan, M. (2007). *The new meaning of educational change* (4th ed.). New York, NY: Teachers College Press.

Galal, N. (2013). *The private lesson in Kuwait is in crisis.* Alkuwaityah newspaper publisher.

Gall, M. D., Gall, J. P., & Borg, W. R. (2006). *Educational research: An introduction (8th Edn.)*. Boston: Allyn & Bacon.

Galton, M. (1998). Class size: a critical comment on the research. *International Journal of Education Research*. 29. 809-818.

Gilbert, W. (2010). Developing Culturally Based Science Curriculum for Native American Classrooms. In Reyhner, J., Gilbert, W. S. and Lockard, L. (Eds.). (2011). *Honoring Our Heritage: Culturally Appropriate Approaches to Indigenous Education* (pp. 43-55). Flagstaff, AZ: Northern Arizona University.

Gillham, B. (2000). *Case study research methods.* London: Continuum.

Glitz, B. (1998). *Focus Groups for Libraries and Librarians.* New York: Forbes.

Gorard, S. (1999). *Quantitative Methods in Educational Research*. London: Continuum.

Gephart, R. (1999). Paradigms and research methods. *Research Methods Forum, 4* (Summer), Retrieved October 15, 2012 from the Academy of Management website, http://division.aomonline.org/rm/1999_RMD_Forum_Paradigms_and_Research Methods.htm.

Grbich, C. (2013). *Qualitative data analysis: An introduction (2nd Edn.)*. London: Sage.

Greenberg E. & C. Webster. (1983). *Advanced Econometrics: A Bridge to the Literature.* New York: Wiley.

Greene, H. (1993). *Econometric Analysis.* New York: Macmillan Publishing

Griffin, R. (2006). *Education in the Muslim World: Different Perspectives,* Didcot, UK: Symposium books.

Grossman, G., Onkol, P., Sands, M., (2007). Curriculum Reform in Turkish Teacher Education: Attitudes of Teacher Educators towards Change in an EU Candidate Nation', *International Journal of Educational Development*, 27, 138 – 150.

Guarino, N., Oberle, D., & Staab, S., (2009). *What Is an Ontology? Handbook on Ontologies.* International Handbooks on Information Systems, 1-17.

Guessoum, N. (2008). The Qur'an, Science, and the (Related) Contemporary Muslim Discourse. *Zygon®*, *43*(2), 411-431.

Ha, A. S., Wong, A. C., Sum, R. K., & Chan, D. W. (2008). Understanding teachers' will and capacity to accomplish physical education curriculum reform: The implications for teacher development. *Sport, Education and Society*, *13*(1), 77-95.

Haidar, A. (2000). Professors' Views on the Influence of Arab Society on Science and Technology. *Journal of Science Education and Technology, 9* (3), 257-273.

*Handbook of the Education in Kuwait (1998).* Ministry of Education in Kuwait.

*Handbook of the Education in Kuwait (2012).* Ministry of Education in Kuwait.

Handler, B., (2010). Teacher as Curriculum Leader. *International Journal of Teacher Leadership, 3* (3), 32 – 42.

Hanley, P. (2012). The inter-relationship of science and religious education in a cultural context: teaching the origin of life. Doctoral dissertation, University of York.

Harrison, C. (2003). Visual social semiotics: understanding how still images make meaning. *Technical Communication, 50* (1), 46-60.

Harland, T (2003). Vygotsky's Zone of Proximal Development and Problem-based Learning: linking a theoretical concept with practice through action research. *Teaching in Higher Education, 8* (2), 263 – 272.

Harlen, W. (1999). *Effective Teaching of Science. A Review of Research.* Edinburgh: Scottish Council for Research in Education.

Hays, W. L. (1994). *Statistics (5th edn.).* New York: Holt, Rinehart and Winston.

Henry, G. (1990). *Practical sampling*. Newbury Park: Sage Publications.

Hesse-Biber, S. N., & Leavy, P. (2010). *The practice of qualitative research. (2nd edn)* London: Sage.

Hismanoglu, M. (2012). The impact of globalization and information technology on language education policy in Turkey. *Journal of Procedia – Social and Behavioral Sciences,* 30, 629-633.

Hopkins, D. (2008). *The practice and theory of school improvement: international handbook of educational change.* New York: Springer.

How, A.C (1996): Development of Science Concept within a Vygotskian Framework, *Science Education, 80* (1), 35- 51.

Idris, F., Hassan, Z., Ya'acob, A., Gill, S., Aziah, N., & Awal, M., (2012). The role of education in shaping youth's national identity. *Social and Behavioral Sciences*, 59, 443–450.

Ismail, H. (2003). The development of the education system in Kuwait. *Journal of*

*Education management. 2*(2), 121- 139. [In Arabic].

I-TECH's Technical Implementation Guides (2008). *Piloting a Curriculum: Evaluating the Effectiveness of a New Training*. The International Training and Education Center for Health (I-TECH): University of Washington.

Jackson, D. (2005). *Why Pupils' Voice? Facilitating Pupil Involvement in Learning Networks,* NCSL.

Janesick, V. (1998). *'Stretching' exercises for qualitative researchers*. Thousand Oaks: Sage.

Jassim, S. (2002). The scientific literacy in Kuwaiti science curriculum. *Journal of Education. 17* ( 65). 35-51. [In Arabic].

Jenkins, E. (2013). 'The nature of science in the school curriculum: the great survivor.' *Journal of Curriculum Studies. 45*(2), 132-151.

Johnson, B., & Christensen, L. (2012). *Educational research: Quantitative, qualitative, and mixed approaches (4th Edn.)*. Thousand Oaks, CA: Sage.

Johnson, B., & Turner, L. A. (2003). Data collection strategies in mixed methods research. In A. Tashakkori, and C. Teddlie (Eds.), *Handbook of mixed methods in social and behavioural research* (pp. 297-319). Thousand Oaks, CA: Sage.

Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational Researcher*. 33 (7) 14-26.

Joppe, M. (2000). The research process [Online], Ryerson University Press. Available from: <http://www.ryerson.ca/~mjoppe/rp.htm> [Accessed 11 May 2012].

Kadushin, A. & Kadushin, G. (1997). *The social work interview: A guide for human service professionals (5th Edn).* New York: Columbia University Press.

Kali, Y., Linn, M.C., & Roseman, J.E. (Eds.) (2008). *Designing coherent science education: Implications for curriculum, instruction, and policy*. New York: Teachers College Press.

Kalin, I. (2006). Islam and Science: notes on an ongoing debate, in A. Eisen & G. Laderman (Eds) *Science, Religion, and Society: an encyclopaedia of history, culture, controversy.* Armonk: M.E. Sharpe.

Kelly, V (2009). *The Curriculum: Theory and Practice, Sixth Edition.* London: Sage.

Kesidou, S., & Roseman, J. E. (2002). How well do middle school science programs measure up? Findings from Project 2061's curriculum review. *Journal of Research in Science Teaching*, *39*(6), 522-549.

Keys, C.W. & Bryan, L.A. (2001) Co-constructing inquiry-based science with teachers: Essential research for lasting research. *Journal of Research in Science Teaching, 38*(6), 631-645.

Khaled, A. (1999). *Status of Science Teachers in Kuwait*. Kuwait University. [In Arabic].

Khan, S. (2010). Education and agency: Muslim women and the tensions of traditional and modern expectations. (Dissertation.) Harvard University, USA.

Kibirige I, Osodo J, *Kgasago* D (2013). Grade Seven Female Learners' Attitudes towards Natural Sciences in Sekhukhune District, South Africa. *Mediterranean Journal of Social Sciences 4* (14) 37- 44.

Kirdar, S. (2006). The Development of Woman's Education in the Arab World. In Griffin, R. (2006). *Education in the Muslim World: Different Perspectives*. Didcot, UK: Symposium books.

Klein, F. (1991). *The politics of curriculum decision making: Issues in centralizing the curriculum*. Albany, NY: State University of New York Press.

Kotte, D. (1992). *Gender differences in science achievement in 10 countries.* Frankfurt: Peter Lang.

Kozulin, A., Gindis, B., Ageyev, V., & Miller, S. (Eds,), (2003). *Vygotsky's educational theory in cultural context.* Cambridge: Cambridge University Press

Kumar, R. C. (2008). *Research Methodology*. New Delhi: Balaji Offset.

Kuutti, K. (1996). Activity theory as potential framework for human-computer interaction research. In B. Nardi (ed.) *Context and Consciousness: Activity Theory and Human Computer Interaction*. Cambridge: MIT Press.

Kuwait Government Online (2013). Kuwait Administrative Division. http://www.e.gov.kw/sites/kgoenglish/portal/Pages/Visitors/AboutKuwait/KuwaitAtaGlane_Topography.aspx. [Accessed 10 February 2013].

Kuwait Population, Report of the (2012). Published by: The Public Authority for Civil Information in Kuwait.

Kuwait, State of. World Atlas (2013) [Online], World Atlas Web Site. Available: <http://go.hrw.com/atlas/norm_htm/kuwait.htm> [Accessed 20 July 2013].

Kyriacou, C. (2009). *Effective Teaching in School: Theory and Practice*. Cheltenham: Nelson Thornes.

Leat, D., & Reid, A. (2012). Exploring the role of student researchers in the process of curriculum development, *Curriculum Journal*, *23*(2), 189-205.

Lee, Y. (2003). An evaluation of the new junior secondary science curriculum in Hong Kong. PhD thesis, University of London, Institute of Education.

Leininger, M. M. (1985). Ethnography and ethnonursing: Models and modes of qualitative data analysis. In M. M. Leininger (Ed.), *Qualitative research methods in nursing* (pp. 33-72). Orlando, FL: Grune & Stratton.

Lemke, J. L. (2001). Articulating communities: Socio-cultural perspectives on science education. *Journal of Research in Science Teaching*, *38*(3), 296-316.

Levin, B. (2000). Putting Students at the Centre in Education Reform. *Journal of Educational Change*, *1*(2), 155- 172.

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Beverly Hills, CA: Sage.

Loo, S., (2001). Islam, science and science education: conflict or concord? *Studies in Science Education*, 36, 45-77.

Lunenburg, C. F. (2011). Key Components of a Curriculum Plan: Objectives, Content, and Learning Experiences. *Schooling*, 2(1).

Mack, L. (2010). The philosophical underpinnings of educational research. *Polyglossia*, 19, 5-11.

MacNaughton, G. M., Rolfe, S. A. and Siraj-Blatchford, I. (2001). *Doing early childhood research: international perspectives on theory and practice*. Buckingham: Open University Press.

McGinn, R. (1991). *Science, technology, and society*. Englewood Cliffs, NJ: Prentice Hall.

McMillan, J. H., & Schumacher, S. (2010). *Research in education: Evidence-based inquiry (7th Edn.)*. Boston: Pearson.

Mahner, M., & Bunge, M. (1996). Is religious education compatible with science education? *Science & Education*, *5*(2), 101-123.

Manefield, J., Collins,R., Moore,J., Mahar,S. & Warne C. (2007). *Student Voice: a historical perspective and new directions*. Department of Education, Melbourne.

Mansell, W., James, M. & the Assessment Reform Group (2009) *Assessment in schools. Fit for purpose? A Commentary by the Teaching and Learning Research Programme*. London: Economic and Social Research Council, Teaching and Learning Research Programme.

Mao, Ch., (2008) 'Fashioning Curriculum Reform as Identity Politics —Taiwan's Dilemma of Curriculum Reform in the New Millennium', *International Journal of Educational Development*, 28, 585–595.

Mansour, N. (2008a). The experiences and personal religious beliefs of Egyptian science teachers as a framework for understanding the shaping and reshaping of their beliefs and practices about Science-Technology-Society (STS). *International Journal of Science Education*, *30* (12), 1605–1634.

Mansour, N. (2008b). Religious beliefs: A hidden variable in the performance of science teachers in the classroom *European Educational Research Journal*, *7* (4), 557-576.

Mansour, N. (2009). Religion and science education: An Egyptian perspective. In S. BouJoaude and Z. Dagher (Eds.) *The World of Science Education: Handbook of Research in the Arab States* (pp. 107-132). Rotterdam: Sense Publishers.

Mansour, N. (2010). Science teachers' interpretations of Islamic culture related to science education vs. the Islamic epistemology and ontology of science. *Cultural Studies of Science Education. 5*(1), 127-140.

Mansour, N. (2011). Egyptian science teachers' views of science and religion vs. Islamic perspective: conflicting or complementing? *Science Education.* (95), 281-309.

Mansour, N. (2013). Modelling the Sociocultural Contexts of Science Education: The Teachers' Perspective. *Research in Science Education*. 43,347–369.

Marsh, C. J. (2009). *Key Concepts for Understanding Curriculum – 4th Edition.* UK: Routledge.

Marsh, C., & Willis, P. (2003). *Curriculum: Alternative approaches, ongoing issues (3rd Edn)*. Upper Saddle River, NJ: Merrill/PrenticeHall.

Martin, B., Kass, H. & Brouwer, W. (1990) Authentic science: a diversity of meanings. *Science Education* 74, 541-554.

Martin, M., Mullis, I., Foy, P., & Stanco, G. (2012). *TIMSS 2011 International Results in Science*. TIMSS & PIRLS International Study Center, Lynch School of Education, Boston College. Chestnut Hill, MA, USA.

Manuguerra, M., & Petocz, P. (2011). Promoting Student Engagement by Integrating New Technology into Tertiary Education: The Role of the iPad. *Canadian Center of Science and Education, 7* (11), 61- 64.

Mathison, S. (1988). Why triangulate? *Educational Researcher, 17*(2), 13-17.

Maxwell, J. (2005). *Qualitative Research Design: An Interactive Approach*. California: Sage Publications.

Meador, K. S. (2003). Thinking creatively about science. *Journal for the Education of the Gifted, 26* (1), 25-29.

Melville, W. (2009). Curriculum reform and a science department: A Bourdieuian analysis. *International Journal of Science and Mathematics Education, 8,* 971–991.

Meurant, R. (2010). iPad Tablet Computing to Foster Korean EFL Digital Literacy. *International Journal of u- and e- Service, Science and Technology 3,* (4), 49- 62.

Micceri, T. (1989). The Unicorn, the Normal Curve, and Other Improbable Creatures. *Psychological Bulletin*, *105* (1), 156-166.

Millar, R. (2011). Reviewing the National Curriculum for Science: Opportunities and Challenges. *The Curriculum Journal*, 22 (2), 167–185.

Mingaleva, Z., and Mirskikh, I. (2012). Globalization in education in Russia. *Journal of Procedia – Social and Behavioral Sciences*, 47, 1702-1706.

Ministry of Planning Report (2012), Statistics and Information Sector. Kuwait.

Mohamad, A. (1998). Development of science curriculum in Arab countries. *Journal of Education* 1(2), 1–19. [In Arabic].

Muijs, D. (2011) *Doing quantitative research in education with SPSS.* (2nd Edn). London: Sage.

Mullah, A. (2000). Development of the Kuwait student’s skills. *Alsalam Journal,* 1(2). 10-31. [In Arabic].

Murray, I. & Reiss, M.J. (2005) The student review of the science curriculum. *School Science Review, 87*(318), 83-93.

Murray, O. & Olcese, N. (2011). Teaching and Learning with iPads, Ready or Not? *TechTrends* . ( November/December 2011), 55 (6), (42 – 48).

Nashwan, Y. (1993). Evaluation of secondary school science teaching objectives in the Arab world. In M. Debs (Ed.), *Proceedings of the first scientific conference on the future of science and mathematics teaching and the needs of Arab society,* Tunisia, 19–22 December [In Arabic] (pp. 122–141). Beirut, Lebanon: Arab Development Institute.

Newby, P. (2010). *Research Methods for Education*. Harlow, Essex: Pearson Education.

Ni, Y., Li, Q., Li, X., and Zhang, Z. (2011), 'Influence of curriculum reform: An analysis of student mathematics achievement in Mainland China', *International Journal of Educational Research*, 50, 100-116.

Nord, W. A., & Haynes, C. C. (1998). *Taking religion seriously across the curriculum*. ASCD.

Nulty, D. (2012). Curriculum Design: You're Teaching Strategy. Learning, Teaching and Higher Education Research. Griffith Institute for Higher Education.

Oates, B. J. (2006). *Researching information systems and computing*. London: Sage.

Obeikan Education (2012). New science curriculum in Saudi Arabia and Bahrain. From http://obeikaneducation.com/obeikanmodules/supportpage/k12_edu [Accessed on: May 20, 2012].

Oppenheim, A. N. (2000). *Questionnaire Design, Interviewing and Attitude Measurement*. London: Continuum International Publishing Group.

Orafi, S., & Borg, S., (2009). Intentions and Realities in Implementing Communicative Curriculum Reform', *System,* 37, 243 – 253

Orlikowski, W. & Baroudi, J. (1991) Studying information technology in organizations: research approaches and assumptions. *Information Systems Research.* 2(1), pp.1-28.

Orpwood, G (2001). The role of Assessment in science curriculum reform. *Assessment in Education principles, policy and practice, 8* (2) 135-151.

Pajares, F. (1997). Current directions in self-efficacy research. In M. L. Maehr & P. R.Pintrich (Eds.), *Advances in motivation and achievement,* 10. 1-49.

Patton, M. Q. (2002). *Qualitative evaluation and research methods* (*3rd Edn.)*. Thousand Oaks, CA: Sage Publications, Inc.

Pauwels, L. (2006) A Theoretical Framework for Assessing Visual Representational Practices in Knowledge Building and Science Communications. In L. Pauwels, (Ed.), *Visual Cultures of Science: Rethinking Representational Practices in knowledge building and science communication*. Lebanon, NH: Dartmouth College Press, pp. 1-25.

Peterson, R, A. (2000), *Constructing Effective Questionnaires*. Thousand Oaks, CA: Sage.

Portelli, J. P. (1987). Perspectives and Imperatives on Defining Curriculum. *Journal of Curriculum and Supervision*, *2* (4), 354–367.

Prokop, P., Tuncer, G. & Chudá, J. (2007). Slovakian Students' Attitudes toward Biology. *Eurasia Journal of Mathematics, Science & Technology Education*, *3*(4), 287-295.

Qualifications Curriculum Development Agency (QCDA), (2010). *Aims, Values and Purposes*. http://curriculum.qcda.gov.uk/key-stages-3-and-4/aims-values-and-purposes/ index.aspx. [Accessed 15.11.2011].

Radnor, H. (2001). *Researching your Professional Practice*. Buckingham: Open University Press.

Raphaeli, N. (2005). Demands for Reforms in Saudi Arabia *Middle Eastern Studies*. *41* (4), 517- 532.

Rasinen, A. (2003). An Analysis of the Technology Education Curriculum of Six Countries. *Journal of Technology Education,* 15 (1).

Rea, L. M. & Parker, R. A. (2005). *Designing and Conducting Survey Research: A Comprehensive Guide (3rd Edn.)*. San Francisco: Jossey-Bass Publishers.

Reiss, M. J. (1993). Science. In, *The Multicultural Dimension of the National Curriculum*, King, A. & Reiss, M.J. (Eds), Falmer Press, London, pp. 63-77.

Reiss, M. J. (2000). Teaching science in a multicultural, multi-faith society. In: *Issues in the Teaching of Science*, Sears, J. & Sorensen, P. (Eds), Routledge Falmer, London, pp. 16-22.

Reiss, M. J. (2002). Reforming school science education in the light of pupil views and the boundaries of science. *School Science Review, 84*(307), 71-77.

Reiss, M. J. (2006). Listening to pupils. In: *What is Science Education For?*, Gilland, T. (Ed.), Academy of Ideas, London, (pp. 41-46.)

Reiss, M. J. (2008). Should science educators deal with the science/religion issue? *Studies in Science Education*, *44*(2), 157-186.

Reiss, M. J. (2010). Science and religion: Implications for science educators. *Cultural Studies of Science Education*, *5*(1), 91-101.

Reiss, M. J. (2012). What should be the role of religion in science education and bioethics? In *Sacred Science?* (pp. 127-139). Wageningen Academic Publishers.

Reiss, M. J. (2013). Religion in science education. In Mansour, N. & Wegerif, R. (Eds). *Science Education for Diversity in the Knowledge Society: Theory and Practice*, (pp. 317-328). New York: Springer.

Reiss, M. J. & White, J. (2013). *An Aims-based Curriculum: The Significance of Human Flourishing for Schools*. IOE Press, London.

Robottom, I., & Norhaidah, S. (2005). Western Science and Islamic Learners: Informing Constructivism, Quality Learning and 'Internationalizing the Curriculum'. *International Conference on Science and Mathematics Education: Bridging the theory-practice gap in science and mathematics education: the challenge to change*, (pp. 1-8,) December 2005. SEAMEO Regional Centre for Education in Science and Mathematics, Penang, Malaysia. Available at: [http://www.recsam.edu.my/cosmed%202013/cosmed05/AbstractsFullPapers2005/files%5Csubtheme1%5CIR.pdf].

Robson, C. (2002). *Real world research: a resource for social scientists and practitioner-researchers*. *(2nd edn)* Oxford: Blackwell.

Rogoff, B. (1990). *Apprenticeship in thinking: Cognitive development in social context*. New York: Oxford University Press.

Rossman, G.B. & Rallis, S.F. (2012). *Learning in the field: An introduction to qualitative research. (3rd Edn.)*. London: Sage.

Rugh, W. (2002). Arab Education: Tradition, Growth and Reform. *Middle East Journal*, *56* (3) (Summer, 2002), 396-414.

Ryder, J. (2014). Teachers' experiences of external science curriculum reform: A review of empirical studies. Paper presented in NARST conference, Pittsburgh PA, March 30 – April 2, 2014.

Ryder, J. & Banner, I. (2010). 'Multiple aims in the development of a major reform of the National Curriculum for Science in England.' *International Journal of Science Education,* 1-17.

Ryder, J. & Banner, I. (2013). 'School teachers' experiences of science curriculum reform.' *International Journal of Science Education 35*(3), 490-514.

Ryder, M. (1998). The World Wide Web and the Dialectics of Consciousness. Proceedings of the 4th Congress of the International Society for Culture Research and Activity Theory, Aarhus, Denmark, June 7- 11.

Saad, S. (2001). The challenges in Kuwait Education. *Journal of the international study in Education*, *21*(2), 112-145. [In Arabic].

Saha, L., & Dworkin, A (Eds.). (2009). *International Handbook of research on Teachers and Teaching*. New York: Springer.

Saed, F. (1996). Teaching science curriculum in Kuwait school. *Journal of Basic Education. 16* (3), 12-30. [In Arabic].

Sahlberg, P. (2006) Education Reform for Raising Economic Competitiveness. *Journal of Education Change 7* (4), 259-287.

Salamah, A. (2012). *Planning the Contemporary Curriculum*. The Culture House publisher. Jordan.

Saldana, J. (2013). *The coding manual for qualitative researchers (2nd ed.)*. London: Sage.

Salem, A. (2000). The science teacher role in Kuwait schools. *Journal of Education. 33*(2), 69–81. [In Arabic].

Salleh, K. M., Othman, M. Y. H., Radiman, S., Dakir, J., Tamuri, A. H., Alwi, N. H., & Badzis, M. (2011). Teachers' Concerns, Perception and Acceptance toward Tauhidic Science Education. *Kyoto Bulletin of Islamic Area Studies*, 4-1&2 (March 2011), 124–155.

Salman, F. (2005). How can develop the education? *Journal of the Education Research, 13*(4) 32- 51. [In Arabic].

Schubert, W. H. (1993). Curriculum reform. In G. Cawelti (Ed.), *Challenges and achievements of American education: The 1993 ASCD yearbook* (pp. 80-115). Alexandria, Virginia: Association for Supervision and Curriculum Development.

Scott, D. and Morrison, M. (2006). *Key ideas in educational research.* Continuum International Publishing.

Schwab, J. (1969) 'The practical: A language for curriculum*', School Review 78*(1), 1-23.

Schwandt, T. A. (2001). *Dictionary of qualitative inquiry (2nd Edn.)* Thousand Oaks, CA: Sage.

Science Curriculum Adaptation Committee, Report of. (2008). The Curriculum sector in Kuwait, Ministry of Education.

Science Curriculum Reform Committee, Report of. (2002). The Curriculum sector in Kuwait Ministry of Education.

*Science teacher guide book (2012)*. Ministry of Education in Kuwait.

Scott, P (1998). Teacher Talk and Meaning Making in Science Classrom: a Vygotskian Analysis and Review. *Studies in Science Education*, 32, 45- 80.

Scott, S., & Palincsar, A. (2009). *Sociocultural theory.* Available at: http://www.education.com/reference/article/sociocultural-theory

Seiler, G. (2001). Reversing the 'standard' direction: Science emerging from the lives of African American students. *Journal Research in Science Teaching, 38* (9), 1000-1014.

Shah, R. (2012). Goodbye conflict, hello development? Curriculum reform in Timor-Leste. *International Journal of Educational Development*, *32*, 31–38.

Sharpe, K. (2002). Camellias and Happiness: An Integration of Science and Religion. *Quodlibet*, 4(1).

Shenton, A. (2004). Strategies for ensuring trustworthiness in qualitative research projects. *Education for Information 22,(2), 63–75.*

Shin, T. S., Koehler, M. J., Mishra, P., Schmidt, D. A., Baran, E., & Thompson, A. D. (2009). Changing Technological Pedagogical Content Knowledge (TPACK) through course experiences. In I. Gibson, R. Weber, K. McFerrin, R. Carlsen, & D. A. Willis (Eds.), *Society for Information Technology and Teacher Education International Conference book, 2009* (pp. 4152–4156). Chesapeake, VA: Association for the Advancement of Computing in Education (AACE).

Singh, S. (2006). The Interface between Islam and the West in Politics: intellectual awakening and education in the Middle Ages. In Griffin, R. (2006). *Education in the Muslim World: Different Perspectives*, Didcot, UK: Symposium books.

Skilbeck, M. (1990). *Curriculum reform: an overview of trends.* London: OECD Publishing.

Slavin, R.E. (1991) *Research Methods in Education: A Practical guide. 2nd Edn.* Allyn and Bacon. Inc.

Smith, Z., & Wells, C. (2006). Central Limit Theorem and Sample Size. Paper presented at the annual meeting of the NorthEastern Educational Research Association, Kerhonkson, New York, October 18-20, 2006.

Snedecor G.W. & Cochran, W.G. (1980). *Statistical Methods (7th edn).* Ames, Iowa: Iowa State University Press.

Soini, H., Kronqvist, E.L., & Huber, G. (2011). Epistemologies for qualitative research. *Qualitative Psychology Nexus*, Vol.8. Center for Qualitative Psychology, Germany.

Spackman,F.(1991). *Teachers Professional Responsibilities*. London, David Fulton.

Shaw, K. (2006). Muslim education in the Gulf states and Saudi Arabia: Selected issues. In R. Griffin (Ed.), *Education in the Muslim world: Different perspectives* (pp. 41–54). Oxford: Symposium Books.

Shymansky, J. A. and Kyle, W. C. Jr. (1992) Establishing a Research Agenda: Critical Issues of Science Curriculum Reform. *Journal of Research in Science Teaching 29* (8), 749-778.

Smith, E. (2010a). Is there a crisis in school science education in the UK?' *Educational Review 62*(2), 189-202.

Strauss, A., & Corbin, J. (1998). *Basics of qualitative research* (2nd ed.). Newbury Park, CA: Sage.

Su, S. W. (2012). The Various Concepts of Curriculum and the Factors Involved in Curricula Making. *Journal of Language Teaching and Research*, *3* (1), 153-158.

Sultan, G., Fyath, F. (1993). *Geography of Kuwait.* Dar Almarefah Puplisher. Kuwait. [In Arabic].

Talal, R. (2000). *The education in Kuwait*. Analysis study published by Arabic Book publisher. Cairo. [In Arabic].

Tashakkori, A., & Teddlie, C. (2003). *Handbook of mixed methods in social & behavioral research.* Thousand Oaks, CA: Sage.

Thijs, A. & van den Akker, J. (2009). *Curriculum in Development*. Enschede, The Netherlands: SLO.

Toombs, W. E. & Tierney, W. G. (1993). Curriculum Definitions and Reference Points. *Journal of Curriculum and Supervision, 8* (3), 175–195.

Toplis, R. & Golabek, C. (2010). *How Science Works: a longitudinal study of pre-service teachers' field experiences of science curriculum change in England*. Abingdon: Routledge.

Toplis, R., Golabek, C. & Cleaves, A. (2010). Implementing a new science National Curriculum for England: how trainee teachers see the How Science Works strand in schools.' *Curriculum Journal 21*(1), 65-76.

Tsolidis, G. (2011). Dressing the National Imagery. In Yates, L. & Grumet, M. (Eds.), *Curriculum in Today's World: Configuring Knowledge, Identities, Work and Politics* (pp. 17-30). Oxon: Routledge.

Tucker & Ortiz, (2007). Weighting individual datum for nonparametric analysis. Paper presented at the 2007 National Meeting of the American Society of Mining and Reclamation, Gillette, WY, 30 Years of SMCRA and Beyond June 2-7, 2007. R.I. Barnhisel (Ed.) Published by ASMR, 3134 Montavesta Rd., Lexington, KY 40502.

Van den Akker, J.J.H. (2003). Curriculum perspectives: an introduction. In J. van den Akker, W. Kuiper & U. Hameyer (Eds.). *Curriculum landscape and trends*. Dordrecht: Kluwer Academic Publishers.

Van den Akker, J., Fasoglio, D., and Mulder, H. (2010). *A curriculum perspective on Plurilingual Education,* Strasburg: Council of Europe, Directorate of Education and Languages.

Voogt, J., Westbroek, H., Handelzalts, A., Walraven, A., McKenny, S., Pieters, J., and de Vries, B. (2011), 'Teacher learning in collaborative curriculum design', *Journal of Teaching and Teacher Education,* 27, 1235-1244.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes* (M. Cole, V. John-Steiner, S. Scribner, & E. Souberman, Eds.). Cambridge, MA: Harvard University Press.

Vygotsky, L. S. (1987). *Thinking and speech* (N. Minick, Trans.). In R. W. Rieber &A. S. Carton (Eds.), *The collected works of L. S. Vygotsky*. Vol. 1. *Problems of general psychology*, (pp. 39–285). New York: Plenum Press.

Waite, T. (2005). Activity Theory. Retrieved on 02/06/07 from http://www.slis.indiana.edu/faculty/yrogers/act_theory2/

Walker, D. (2003). *Fundamentals of curriculum: Passion and professionalism*. Mahwah, NJ: Lawrence Erlbaum Associates.

Waldrip, B. G., & Taylor, P. C. (1999). Permeability of students' worldviews to their school views in a non-Western developing country. *Journal of Research in Science Teaching*, 36, 289–303.

Wallen, N. & Fraenkel, J. (2001). *Educational research: a guide to the process*. (2nd Edn), New Jersey: Lawrence Erlbaum Associates Publishers.

Wellington, J. (2000). *Educational Research: Contemporary Issues and Practical Approaches.* London. Continuum.

Wells, G. (1999). *Dialogic inquiry: Towards a sociocultural practice and theory of education.* Cambridge, Cambridge University Press.

Woodbury, S., & Gess-Newsome, J. (2002). Overcoming the Paradox of Change Without Difference: A Model of Change in the Arena of Fundamental School Reform. *Educational Policy*. *16* (5), 763-782.

Wiles, J., & Bondi, J. (2007). *Curriculum development: A guide to* practice (7th. Edn.). Upper Saddle River, NJ: Prentice Hall.

World Bank, The. (2008). *The road not travelled: Education reform in the Middle East and North Africa.*

http://siteresources.worldbank.org/INTMENA/Resources/EDU_Flagship_Full_ENG.pdf. [Accessed 12 April 2011].

Wragg, E.C. (2012). *Introduction to classroom observation. (Classic edition)*. London: Routledge

Yilmaz, O., Boone, W. J. & Andersen, H. O. (2004). Views of elementary and middle school Turkish students toward environmental issues. *International Journal of Science Education*, *26* (12), 1527-1546.

Yin, R.K. (2003) .*Case Study Research. Design and Methods. (3rd Edn)*. London Sage.

Yin, R. K. (2006). Mixed methods research: Are the methods genuinely integrated or merely parallel? *Research in the Schools*, *13*(1), 41-47.

Zakaria, E., & Iksan,Z. (2007). Promoting Cooperative Learning in Science and Mathematics Education: A Malaysian Perspective. *Eurasia Journal of Mathematics, Science & Technology Education*, 2007, 3(1), 35-39.

Zellman, G., Ryan, G., Karam, R., Constant, L., Salem, H., & Gonzalez, G. (2009). *Implementation of the K-12 Education reform in Qatar's Schools*. Santa Monica, CA: The Rand Corporation.

# Appendices

# Appendix 1

## Science Teacher Questionnaire

Dear Teachers …

This questionnaire was designed to consult your views regarding the new science curriculum. This questionnaire as part of the research project I am carrying out at University of Exeter in England to explore the science teachers' view about the new science curriculum in grade sixth and seventh. This questionnaire is dividing to three parts; *Demographic information, Closed-ended Questions and Open-Ended Questions*, and is taking 15-25 minutes to complete. I would very much appreciate your participation in this questionnaire.

All information you provide will be held and treated confidentially by the researcher, and you will not be identified by your responses. **If you could complete the attached questionnaire and return it to the researcher,** I would be extremely grateful.

*Many thanks for your co-operation.*

**Yours sincerely**

**Ahmad Alshammari**

Kuwait No: 00965-6651191

Email: Ahmad-shallal@hotmail.com

**Part One: Demographic information**

**1. The grades you are teaching:-** *please choose one and your answer have to be relate with your grade chosen:*

☐ Sixth grade ☐ Seventh grade ☐ Both

**2. Are you taught the old science curriculum in this grade?**

☐ Yes ☐ No

**3. Your Gender is :**

☐ Male ☐ Female

**4. Last Degree Obtained:**

☐ Bachelor ☐ Master ☐ Doctorate - Other…………….

**5. How Long Have You Been Teaching?**

☐ 2-5 years ☐ 6 – 10 years ☐ 11 – 15 years ☐ 16- 20 years ☐ Over 20 years

**6. Position**:

☐ Teacher ☐ Head teacher

**7. Specialisation:**

☐ Science educational ☐ General science ☐ Physics ☐ Chemical ☐ Biology
☐ Geology **-** Other ……………………..

**Part Two: Open / Closed-ended Questions**

**To what extent do you agree with the following statements about YOUR views of current science curriculum in grade six and *seven*.** *Please give your answer with a tick the box on each line.*

| **1. What is your view about the Content of the new science curriculum in stage Six and Seven?** | Strong agree | Agree | Disagree | Strong disagree |
|---|---|---|---|---|
| 1.1 Encourages students to contribute to society. | | | | |
| 1.2 Encourages students to work with others | | | | |
| 1.3 Takes into account individual differences among students | | | | |
| 1.4 Helps students to use Science in their daily life | | | | |
| 1.5 Takes into consideration Kuwaiti student society culture | | | | |
| 1.6 The content of new curriculum are difficult to teaching | | | | |

| **1.7 Use the space below to add other things** |
|---|
| |

| **2. What is your view about the <u>Objectives</u> of the new science curriculum in stage Six and Seven?** | Strong agree | Agree | Disagree | Strong disagree |
|---|---|---|---|---|
| 2.1 Related to Islamic cultural. | | | | |
| 2.2 Linking the fact and scientific concepts in student daily life | | | | |
| 2.3 Suited to the range of the students' abilities | | | | |
| 2.4 Clearly states and easy to understand it | | | | |
| 2.5 Attainable | | | | |
| **2.6 Use the space below to add other things** | | | | |

| **3. What are your views about the new student <u>Assessment</u> system?** | Strong agree | Agree | Disagree | Strong disagree |
|---|---|---|---|---|
| 3.1 Takes into consideration the students' abilities. | | | | |
| 3.2 Gives the opportunity for teacher to use different assessment methods to assess the student. | | | | |
| **3.3 Use the space below to add other things** | | | | |

| **4. What are <u>Your Objects</u> from teaching the new science curriculum for grade Six and Seven?** | Strong agree | Agree | Disagree | Strong disagree |
|---|---|---|---|---|
| 4.1 Help students to understand the content. | | | | |
| 4.2 Preparing the students to school exam | | | | |
| 4.3 Achieve the curriculum objectives | | | | |
| **4.4 Use the space below to add other things** | | | | |

| **5. What are your views about the <u>supports</u> you are receiving from <u>Ministry of Education</u> related to new science curriculum?** | Strong agree | Agree | Disagree | Strong disagree |
|---|---|---|---|---|
| 5.1 Explained for teacher the process of the curriculum reform. | | | | |
| 5.2 Provides clear curriculum teaching plan for new curriculum. | | | | |
| 5.3 I involved in preparing this teaching plan science curriculum. | | | | |
| 5.4 Provides training courses related to new science curriculum. | | | | |
| 5.5 Helping me to solve problems related to the new science curriculum | | | | |
| **5.6 Use the space below to add other things** | | | | |

**5.7 Did you participate for reforming the current new science curriculum?**

☐ Yes ☐ No

**If yes, how can this participate?**

| |
|---|
| |

**5.8 Did you have the opportunity to express new ideas to reform the new curriculum?**

☐ Yes ☐ No

**5.9 Have you had the opportunity to experiment the current science curriculum before implementation?**

☐ Yes ☐ No

**5.10 Did you attend any training or courses related to current science curriculum before implementation?**

☐ Yes ☐ No

**If yes**, Provided by………………………………… – Duration…….……………………….

| **6. What are your views about the <u>supports</u> you are receiving from <u>school</u> related to new science curriculum?** | Strong agree | Agree | Disagree | Strong disagree |
|---|---|---|---|---|
| 6.1 The School provides the teaching tools which I need. | | | | |
| 6.2 The School provides training courses related to new science curriculum | | | | |
| 6.3 The School provided suitable Science lab. | | | | |
| 6.4 The School provided suitable classrooms | | | | |
| 6.5 The School provided Technology library | | | | |

| **6.6 Use the space below to add other things** |
|---|
| |

**7. What are the <u>Instructional Tools</u> you are using in the <u>classroom</u> to teach the new science curriculum?** *( you can chose more than one)*

☐ Smart board ☐ Computer ☐ Overhead Projector ☐ White board ☐ others………….

**7.1 Are these tools are available in your school?** ☐ Yes ☐ No

**8. Which method of teaching do use often?** *( you can chose more than one)*

☐ Lecture ☐ Problem solving learning ☐ Cooperative learning ☐ Discussion others………….

**8.1 Could you explain why do you use this/ these methods?**

| |
|---|
| |

| **9. What are the <u>challenges</u> that facing you and affecting in teaching the new science curriculum?** | Strong agree | Agree | Disagree | Strong disagree |
|---|---|---|---|---|
| 9.1 I have to follow the ministry teaching plan | | | | |
| 9.2 I can change the ministry teaching plan | | | | |
| 9.3 The large number of students in the class are hindered to teaching | | | | |
| 9.4 The workload has hindered me to achieve the curriculum objectives | | | | |
| 9.5 The length of the school academic year are appropriate for teaching the new science curriculum | | | | |
| 9.6 The period of class time is appropriate for teaching the new science curriculum | | | | |
| 9.7 The School assigns me with extra work that is not related to the teacher. | | | | |

| **9.8 Use the space below to add other things** |
|---|
| |

**Dear participant,**

The next stages of this project are an interview and classroom observation. If you wish to participate in the interview and classroom observation, please give me your contact details below.

**Telephone number/Mobile**: …………………………..............................................

**Email**: …………………………......................................................................................

**Name *( if possible)***: …………........................................................................................

*Many thanks for your co-operation.*

# Appendix 2

## Student Questionnaire

Dear students

These questions are about you and your experiences, view and interests related to learning science in your school.

This is not test and not part of your school assessment. This questionnaire is part of the research project for my study.

Your answers are confidential, so please; do not write your name in this questionnaire.

I or your teacher will tell you how to fill in the questionnaire. Please do not start until you are to do so.

If you could complete the attached questionnaire and return it to me or to your teacher**,** I would be extremely grateful.

THANK YOU.

**SECTION ONE: About You**

1. I am ☐ Boy ☐ Girl

2. I am in grade ☐ Six ☐ Seven

| **1. How much do you agree with the following statements about the current science subject in your school?** (Give your answer with tick the box on each line). | Strong agree | Agree | Disagree | Strong disagree |
|---|---|---|---|---|
| 1.1 Science subject is too hard to understand it | | | | |
| 1.2 Science subject is interesting | | | | |
| 1.3 Science subject is rather easy for me to learn | | | | |
| 1.4 I like science subject better than most other subjects | | | | |
| 1.5 The science help me to solve my daily life problems | | | | |
| 1.6 Science subject has encouraged me to work as a team | | | | |
| 1.7 I would like to become a scientist | | | | |

| **2. How much do you agree with the following statements about the current science lessons in your school?** (Give your answer with tick the box on each line). | Strong agree | Agree | Disagree | Strong disagree |
|---|---|---|---|---|
| 2.1 I understand the majority of information in science lessons | | | | |
| 2.2 I like current science lessons | | | | |
| 2.3 I like science lessons because it related to my life | | | | |
| 2.3 I don't like the current science lessons | | | | |
| 2.4 The current science lessons are too hard | | | | |
| 2.5 The science lessons are boring | | | | |
| 2.6 The science lessons are learn me new things | | | | |
| 2.7 The current science lessons should be more practical | | | | |
| 2.8 The current science lessons should be more technology based | | | | |

| **3. Why would you like learning the science?** | Strong agree | Agree | Disagree | Strong disagree |
|---|---|---|---|---|
| 3.1 To use it in my daily life | | | | |
| 3.2 To use it in solve my problem | | | | |
| 3.3 To be scientist in the future | | | | |
| 3.4 To pass the school exam | | | | |

**4. What are the instructional Tools usually used in classroom?** *(Tick all that apply)*

☐ Smart board ☐ White board ☐ Computer ☐ Pictures ☐ Overhead Projector

**5. How do you MOST prefer to be assessed / examined in Science?** *(Tick all that apply)*

☐ Module exams and tests ☐ Practical Exam ☐ Through an oral examination ☐ Through coursework in the science class

**6. How does your science teacher assess you?** *(Tick all that apply)*

☐ Module exams and tests ☐ Practical Exam ☐ Through an oral examination ☐ Through coursework in the science class

| **7. Which of these methods of teaching and learning do you find the most useful and effective in helping understanding your science lessons?** | Strong agree | Agree | Disagree | Strong disagree |
|---|---|---|---|---|
| 7. 1 Taking notes from teacher | | | | |
| 7.2 Reading the text book | | | | |
| 7.3 Copying notes from the board | | | | |
| 7.4 Researching on the internet | | | | |
| 7.5 Going on science trip | | | | |
| 7.6 Having discussion/ debate in class | | | | |
| 7.7 Looking at videos | | | | |
| 7.8 Doing science investigation | | | | |
| 7.9 Cooperative learning | | | | |

***The questionnaire is completed now***

***Thank you***

# Appendix 3

## Protocol of the teachers' semi-structured interview

**Purpose of the interview**

1. Explain the purpose of the study,
2. Develop a relationship of trust with the participant,
3. Describe the extent of the participant's involvement: number of interviews, classroom observations, etc.
4. Gather background information to construct a biography of the participant,
5. Explain what I hope to learn from this study.
6. Discuss what the participant may gain from the study.
7. Ask the participant to share his interest in being part of this study.
8. Ask the participant to read and sign the consent form.
9. Identify the teacher's experience of the curricula and science teaching.
10. Investigate the teacher's views of the science curriculum reform and his/her role in this regard
11. Explore the relationship between the MoE, the school and the teacher.
12. Identify the teacher's views on the new curriculum.

Explore the teacher's views on the new science curriculum, including

a. Curriculum objectives,
b. Curriculum content,
c. Instructional tools,
d. Teaching methods
e. New form of student assessment.

**Interview questions**

**Teachers' background**

- How long have you been teaching?
- What WAs the last degree you obtained? What are your qualifications?
- Describe your teacher education programme and your graduate courses
- Which grades do you teach at present? What other grades have you taught in the past?

**The science curriculum reform process**

- Please tell me what you know about the science curriculum reform process.
- Do you know how the science curriculum was reformed?
- Do you know who reformed the science curriculum?

**Teachers' participation in the curriculum reform**

- Did you participate in designing and reforming the new curriculum? How?
- Do you think the level of participation in the curriculum reform has had an impact in teaching the new curriculum? Could you describe it?

**Teachers and the implementation of the new curriculum**

- Did you have any chance to try out the current science curriculum before it was implemented
- Please tell me how it has impacted on your teaching.

**The objects in teaching the current science curriculum**

- Could you describe the objects you hope to achieve from teaching the science curriculum?
- Has the MoE provided specific objectives for the science curriculum?
- Please could you tell me about the Ministry's objectives, Are they clear to you? Are they suitable for the Islamic and Kuwaiti culture? / for the students' society? Will the new curriculum succeed in attaining these objectives?
- What objectives should science education in Kuwait deliver or focus on? Why?

**The content of the current science curriculum:**

- Could you tell me your views on the content of the current science curriculum?
- Do you think the current content helps students to solve the problems in their everyday lives? Could you give some example?
- Do you think the current content suits the students' culture, religion and everyday environment? Could you explain why/why not?

**Current and former science curriculum**

- Did you teach the old science curriculum? If yes, could you describe what differences there are between the new and the old curriculum? Which is the better? Why?

**The instructional tools:**

- Please tell me about the tools you use in teaching the current science curriculum.
- Are these tools available in the schools?
- If you needed a teaching tool but it wasn't available in your school, could you explain what you would do?
- Does the new curriculum encourage you to use teaching tools?
- Do you think that teaching tools help students to understand a subject?
- To what extent do you use teaching aids in the class?

**Teaching methods**

- What teaching methods do you most use in the classroom? Describe your style of teaching and give examples.
- Why do you like these teaching methods best?
- Does the new curriculum encourage you to use different teaching methods in class?

**The student assessment system:**

- Please tell me about the new student assessment system and your views about it?
- From your experience, what are the advantages and disadvantages of this system?
- Does this assessment affect the achievement of the science curriculum's objectives?

**The relationship between teacher and ministry of education:**

- Please tell me about the supports you are receiving from the MoE.
- Did you receive any support related to the new science curriculum? Could you describe this support?
- If you have problems in teaching new science curriculum, do you think that the Ministry is responsible for solving it? Please explain.
- Please tell me your views on the relationship between the MoE and the teacher.

**The relationship between teachers and their school**

- Please tell me about your relationship with the school administration? How do they help you in teaching and solving your problems?
- What are your roles in the school and the classroom?

**Training courses**

- Did you have any training programmes or workshops about the new science curriculum? If yes, who provided them? Duration? Usefulness? etc.?
- Describe the impact of the courses you may have had on teaching the new curriculum?
- Do you need any more training with regard to the new science curriculum? Why?

**Teaching challenges**

- Please tell me what obstacles you face in teaching the new science curriculum. How do you solve them?

**Teachers' view about the new science curriculum as a whole**

- Please tell me what your views are on the new science curriculum?
- Does it encourage students to learn science? In what way?
- Do you think the current science curriculum needs to change or reform further? Why?

**Would you like to add anything?**

# Appendix 4

## Protocol of the Student group interview

**Purpose of the interview**

13. Explain the purpose of the study,
14. Develop a trusting relationship with the students,
15. Describe the extent of the students' involvement: number of interviews, classroom observations, etc
16. Explain what I hope to learn from this study.
17. Discuss what the students may gain from the study.
18. Ask students to share their interest in being part of this study.
19. Explore students' views about the new science subject.
20. Explore the student view about the science classroom.
21. Identify the relationship between school, teacher and student.
22. Explore the student view about the assessment system.

**Students' definition of science:**

- Please tell me about the science. Could you explain how you can use the science to solve any problem in your daily life, give example?

**Student and science subject:**

- Tell me about the favorite subject for you in the school. Give me the reasons.
- Tell me about the science subject in the school. Do you think the science subject is important for you? Explain.
- Is the science subject easy or difficult? Why?
- Do you understand most of science lessons? Why / why not?

**Science classroom:**

- Explain how you learn in the science classroom.
- Does it offer you the opportunity to discuss the teacher in the classroom?
- Tell me about your role in the classroom.

**Teaching tools**

- Please tell me about the teaching tools which your teacher are using in the classroom.
- Do you find it useful and effective in helping understand the science lessons? Could you explain that?

**Teaching method**

- Tell me about your teacher teaching in the classroom.
- Explain the teaching methods which your teacher using in the classroom.
- Give me examples these methods.
- Which methods of teaching and learning do you find the most useful and effective in helping understand your Science lessons? Why?

**Relationship between student and school**

- If you have any problem in the school, could you tell me how you can solve it.
- If you have problem to understand the science lesson, could you explain what you will do?

**Student assessment**

- Tell me about your assessment system in the school.
- Are you happy for it? Why?
- How do you prefer to assess you in the science? Why

**Would you like to add anything?**

# Appendix 5

## Protocol of semi-structured interview for the curriculum reformers

**Purpose of the interview**

1. Explain the purpose of the study,
2. Develop a relationship of trust with the participant,
3. Describe the extent of the participant's involvement: number of interviews.
4. Gather background information to construct a biography of the participant,
5. Explain what is hoped to be learned from this study.
6. Discuss what the participant may gain from the study.
7. Ask the participant to share his interest in being part of this study.
8. Ask the participant to read and sign the consent form.
9. Identify the part played by the participant in the curriculum reform.
10. Explore the process of reforming the science curriculum:

**The reformers' background**

- What is your current position? Could you tell me about your job experience?
- Please tell me about your role in the science curriculum reform.

**Reasons for the reform**

- Could you explain the reasons of the science curriculum reform?

**The curriculum reformers**

- Could you tell me who worked with you to reform the science curriculum?
- Could you tell me who chose them? Why were these people chosen?
- Please describe the role of the people who were involved in reviewing and reforming the science curriculum.

**Curriculum reform process**

- Please tell me about the process of reviewing and reforming the science curriculum.

**The new science curriculum series**

- Please tell me about the new science curriculum series.
- Could you tell me how you selected this series? Why?
- After the curriculum was selected, could you tell what your next steps were?

**Curriculum adaption**

- Please tell me about the curriculum adaption process and who adapted it?
- What was the basis of the adaptation?
- Describe the challenges in selecting, adapting and reviewing the science curricula. Please give examples
- How did you adapt the science curriculum to suit Kuwaiti society? Please describe the process and give me some example of amendments to the original curriculum.
- How do you ensure the representation of Islamic elements in the science curriculum? Do you have any expertise in adding cultural issues to a science curriculum?
- Did you use any units or topics from the old curriculum? Why/why not?

**Curriculum implementation**

- Could you tell me about the implementation of the new science curriculum?
- Did you pilot the new curriculum before implementing it in schools?
- Did you give the teachers or students the opportunity to view the new curriculum before the implementation?

**Relationship between the Ministry of Education and the teachers**

- Please tell me about the teachers' role in the curriculum reform.
- Were any students, parents, scholars, scientists, teachers or sociologists involved on the adaptation process?
- Could you describe how you helped the teachers to teach the new science curriculum?
- Did you train teachers in the curriculum before/after implementing it?
- Did you involve the teachers in any educational decisions? **Did you face any challenges in the reform process? Could you describe them**

# Appendix 6

## Transcript of an interview with a science teacher

School : AL Hassan Bin Al-Haitham Intermediate school (Boys)

Occupation : Head of Science Department

Date : 15/05/2012

Interview Time : Start 11:00 am End: 12:20 noon

**Q1.** **Personal Information**

- **How many years of teaching experience have you had?** 14 years in science teaching
- **What is your qualification?** B.Sc., Majoring in Science Education
- **Which educational stage are you teaching?** I currently teach $7^{th}$ grade. Previously, I was teaching all classes in the intermediate stage, Grades 6, 7, 8 and 9.
- **Did you teach the previous science curriculum?** Yes, I have taught both the previous and new science curriculum.

**Q2.Could you tell me what you know about the science curriculum reform process?**

First I want to say I am happy about the development and reform of the science curriculum because it had really needed to develop to keep pace with scientific, technological and social developments. Second, all the information I have about the reform process of the science curriculum has been obtained from the newspapers, the media and through questions to the science education inspectors. The Ministry of Education did not inform us about the process of curriculum reform. All the information I know is that this curriculum is an American curriculum which was translated into Arabic and then committees were formed to adapt it.

**What do you think about importing a USA curriculum for use in Kuwait?**
I think it is a good idea because the science education in USA is better than the science education in Kuwait and this can contribute to developing our education. But it is not just imported - it needs to be carefully adapted to be suitable for Kuwait students.

**What about the current state [of science curriculum] in Kuwait?**
I think the problem was in the adaptation stage because it not done successfully but I am not sure it needs many research studies like your research now. Good luck!

**Have you participated in any stage of the curriculum reform process?**

I did not participate in any stage of the reforming of the curriculum and did not hear that any teacher had been involved in any process to do with curriculum reform. We were surprised to have the new curriculum implemented at the beginning of the school year without any testing and without any training courses being provided for the teachers of this curriculum. Not just then, but also because the Ministry hadn't shown any interest in involving teachers in any educational decision.

**Have you attended any training course for the new science curriculum?**

No training courses were conducted until a year after the introduction of the new curriculum. For me, they were short and not very useful. I attended a 5-day training course for 2 hours per day, more than a year after first teaching the new curriculum, where an explanation of the content of the curriculum was delivered. It's always the case that the Ministry of Education doesn't provided a full enough development programme for teachers.

**Has this affected your teaching of the curriculum?**

Yes, of course. I was surprised by the new curriculum. It is quite different from the previous one. There was not enough time to review the current curriculum, so that I found it hard to teach at first. I spent a very long time preparing for each lesson.

**Q3.Please tell me about the support you are receiving from the MOE?**

From my standpoint and my long experience, there is not sufficient support from the Ministry for the teacher, whether for the new science curriculum or in general. I find that the Ministry fails to provide support to the teacher: courses to develop the teacher's skills in teaching are not often provided and the MoE does not contribute much to solving teachers' problems, such as the shortage of books to guide them, instructional tools, or difficulties in teaching. The teachers have to solve these problems alone or with the help of their colleagues in the department. What the Ministry does is only provide textbooks in the school and pay me a monthly salary.

**Are you given any support?**
Maybe from the science inspector, but I think he is not really helpful.
**In what way?**
It is true that the Ministry provides an education inspector to visit teachers in school, but he comes only 2-4 times a year. It is not enough.

**What is the nature of this visit?**
This visit is deemed important because he sometimes solves some of the problems that we face or conveys our views to the Ministry officials. Unfortunately, the education inspector comes to see us mainly to evaluate our performance in the classroom for our annual evaluation. The education inspector also focuses on the commitment of the teacher in not spending too long on each part of the curriculum content and does not concentrate on technical aids for the teacher and the needs or problems involved in them.

**Q4 -What about the support you receive from the school?**

The role of the school is primarily administrative. The school is mainly responsible for organizing the administrative side, from distributing the class timetable to solving some of the teachers' problems, such as reducing the teacher's teaching hours or providing some instructional tools.

**What is your role in the school?**
It is assumed that teachers are fully engaged in teaching and following up their students, giving them the chance to become more focused on work and be more diligent in teaching. Unfortunately, the Ministry and the school encumber teachers by other tasks that have nothing to do with teaching, interfere with the teacher's concentration and affect his teaching performance. The teacher is required, among other tasks, to be a salesman in the school cafeteria or supervise groups of students in their classes to solve and follow up their problems, despite the presence of a psychologist in each school, The teachers are also asked to walk around the playground at break time to monitor the students. Teachers should not be given all these jobs and the Ministry must provide other people to do them.

**Q5. Could you describe what you hope to achieve from teaching science in school?**

Ostensibly, the goal of teaching the science for me is to teach the content of the curriculum and complete it by the date specified at the end of the year. We are committed to complete the courses before a certain time. This is what we directly try to do, because of the pressure on us from the Ministry to complete the curriculum on time.

However, when we teach each lesson to the students, each one has its particular goal. Each topic has goals that should be achieved in every class. Among my objectives also is that the students should understand the subject and purpose of each lesson.

**Could you give me an example?**

For instance, when I describe the parts of the plant to the students, among the objectives of this lesson is that the student should know the names of the parts of the plant the function of each one. To ensure that the objectives have been achieved, the students are asked questions at the end of each class or in written examinations.

**Has the MOE provided specific objectives for the science curriculum?**
Yes, the Ministry of Education determines the science curriculum objectives and sends them to us at the beginning of each academic year, as well as the time specified for teaching the different areas of the curriculum and achieving its goals.

**Did you participate in preparing these objectives?**
No, as I mentioned before, the teachers do not participate in the preparation of these objectives and we may not amend them. The role of the teacher is just to follow the orders of the MoE but not to participate in its decisions.

**Does this impact on your work?**
Of course, of course, of course – the centralised system of the ministry not giving me the freedom to teach science impacts negatively on my work and hinder my creativity.

**Please, could you tell me your views about the objectives of the new science curriculum?**

The objectives set by the Ministry of Education are unclear to me and sometimes incomprehensible, or what is required in teaching this subject is ambiguous. The Ministry delivers the objectives without sufficient explanation about how to achieve them, or adequate explanation to make them easier for the teacher to understand. From my point of view, there are also many defects in these objectives.

**Could you tell me what these defects are?**

I think most of these objectives are difficult to achieve because they are not clear and are generally irrelevant to the students' everyday lives and the way that science can be used in students' lives. I think the objectives of science teaching could be linked to the students' everyday lives and their culture by relating the content of the science lessons and the teaching examples with the students' culture, environment and everyday conditions.

**Why?**

From my experience this will help the students to understand the science more easily.I also find it difficult to achieve most of these objectives through the new curriculum because, as I see it, they are not linked to each other. As you know, this curriculum was developed by an American company but the objectives were set by the Kuwaiti Ministry of Education. Therefore, I think that there is no correlation.

**Could you explain this point in more detail, please?**
I think there some gaps between the new curriculum content and the curriculum objectives because I feel some objectives and the content of the new curriculum are unrelated. Some objectives throughout the curriculum are hard to attain; for example, one of the curriculum objectives is to "help the student learn values ..." or something like that - I can't remember it now. Even now I don't know how I can achieve this object through the science subjects. I think the science curriculum objectives must develop clearer links with the curriculum content.

**Q6.Could you tell me about your view of the current science curriculum content?**

Oh my God, about the new content… the current science curriculum is not just difficult for the students, but is even difficult for the teacher. It was developed in a complex and unclear manner as a textbook for university students, but not for intermediate students in school. It contains a lot of overlapping information and is too long, not commensurate with the student's ability in this phase. The student finds it difficult to understand the content easily or to identify the important information in each lesson. I and the science teachers in my school also sometimes find it difficult to teach this content, for reasons like its excessive size. Time constraints also affect the performance of teachers in delivering this curriculum.

There aren't many practical lessons in the new curriculum, despite the existence of a separate book for scientific experiments.

**What about the correlation of the content with the student's culture and society?**

It's good that you ask me this question, so I can explain that the content has nothing to do with the students' culture and society and their everyday lives. There are no lessons linked to the Islamic, Arab culture, society, or the situation in which the students live. Most of the examples and pictures in most topics are also not related to the students' society and culture. But I want to say that the science subjects take in many things in this world so we can't make science relate to our society and culture alone because this will make the students concentrate too much on their own country and this is wrong.
**Do you think it is important to link the science curriculum with the students' socio-cultural assumptions?** Of course – this is very important.

**Could you explain why and how?**
The student doesn't live in school; he just spends a certain time there. Students have their own lives to lead and are influenced by their social and cultural environment and religion and this affects their thinking and beliefs. It also will affects their learning. For this reason, any curriculum must relate to the students' assumptions so as be easily understood and it is also important for the development of their country. For the science curriculum, I think it is important to mention that the examples and pictures in the textbook should relate to the students' lives because this help them to understand the lessons. It is also it is important to teach the students how they can use science in their everyday lives because this helps in developing their country in the future.

**Could you give me some example of what the Kuwaiti students might need in these lessons?**
Kuwait depends on oil but there are no lessons related to this topic nor any help for the student in finding out more about Kuwait's oil and how the industry can develop and be exploited. Moreover, some diseases are common in Kuwait, such as diabetes, high blood pursues, cancer and heart diseases, but neither the new science curriculum nor the old one takes any interest in these topics, even though Kuwaiti students really need to study them.

**How do you see your role with the new science curriculum as it stands?**
I sometimes do my best to relate the science lessons to the students' culture by suggesting examples relating to Kuwait and I sometimes refer to Qur'anic verses which support the science lessons.

**Q7. Since you have taught both the new and the former curricula, would you explain to me what is the difference between them?**

The old curriculum had many defects, such as that some information in it had become outdated. It actually needed to be developed, reviewed and changed. It was not much concerned with practical work, either. However, we hoped that the new curriculum would be developed in a better way, but it was designed with many flaws such as the amount of content, lack of relevance to the student's culture and society and failure to connect to the curriculum followed earlier by the students. Therefore, you find incoherent themes.

The new curriculum is quite different from the previous one in terms of content, objectives, presentation technique and method of student assessment. In some topics there is no correlation between the two curricula.

**Which one do you prefer?**

As I told you, the previous curriculum was actually in need of reform and development, but the new curriculum is disappointing. I would request that the new curriculum be modified and developed as well. If I had to choose between them, I prefer to return to the previous curriculum and combine the two.

**Q8.Please tell me about the instructional tools that you use in teaching the current science curriculum?**

We face a big problem in the provision of instructional tools for the new curriculum. The Ministry of Education has not provided enough of these tools in all schools, so I've been obliged to buy some from own pocket or sometimes to explain the lesson without any teaching aids, if none is available.

**Haven't you asked the school or the Ministry to provide the necessary tools?**

We asked the Ministry and the school many times and they always reply with promises that these tools will be provided, but so far there has been a severe shortage of them.

**So, what are the tools that you often use in teaching?**

The classrooms in the schools of Kuwait are not fitted with any technological devices to help in the process of teaching. They only have whiteboards, which I always use. I sometimes use pictures and models, or bring a projector with me. If the lesson is in the lab or a practical lesson, I use the tools necessary to conduct the experiment.

**Q9.What are the teaching methods that you use most in the classroom?**

I often use the lecture method although it has several disadvantages. However, I use it because most lessons in the new curriculum are long and contain a lot of information and the time is too short to let me use a variety of teaching methods. I sometimes divide the students into groups to conduct scientific experiments and produce results.

**What would you suggest about that?**

Primarily, in order to allow more variety in the teaching methods, a deal of the content of the new curriculum would have to be omitted to suit the time-allocation for the classes. It would also need more science labs equipped with the latest teaching tools.

**Q9. Please tell me about the new student assessment system and what you think of it.**

Unfortunately, passing the examination is the most important goal of the students in Kuwait, regardless of whether they have benefitted or not. The students know now that the teacher awards the grade in a few areas and therefore, they have started to ignore classroom activities and homework. Some students are not controlling their behaviour in the classroom because they know that a student's conduct cannot change his grade, though it could in the past. From my point of view, the new system is not good and the previous system was much better. The current system makes students more interested in finding ways to pass the examination successfully without paying any attention to the good that the curriculum itself might do them, **WHY?** because more grades are allocated to the examination and only a very few marks are allocated to the student's activity and participation in the classroom. However, it is important to reconsider the new system so that the grades are distributed to acknowledge the student's activities, participation, attendance, behaviour in the classroom, homework, assignments and examination. The focus should not be on the examination alone.

**Q10. Finally, what would you like to add?**

I hope that the Ministry of Education will revise this curriculum again because it has many flaws. If it does, I hope that the teachers, students and parents can participate and have their ideas and perspectives taken into account. We are more informed than anyone about the curriculum, since we deal with it every day, so our views should be included. I would like to thank you for this study, which I hope will help in the development of the science curriculum in Kuwait.

# Appendix 7

## Classroom Observation Form

Class……………………………….. School………………………………..

Subject……………………………… No. of students………………………

Date…………….. Time ………………… Location……………………

| ***Class Structure*** | *Could Improve* | *Acceptable* | *Excellent* | *Not Observed* |
|---|---|---|---|---|
| Made clear statement of the purpose of the lesson | | | | |
| Defined relationship of this lesson to previous lessons | | | | |
| Presented overview of the lesson | | | | |
| Summarized major points of lesson | | | | |
| Responded to problems raised during lesson | | | | |
| Related today's lesson to future lessons | | | | |
| Started and ended class on time | | | | |
| Clearly explained the learning objectives for the class session | | | | |
| Relates knowledge to students' life | | | | |

**Comments:**

| ***Presentation*** | *Could Improve* | *Acceptable* | *Excellent* | *Not Observed* |
|---|---|---|---|---|
| Projected voice so easily heard | | | | |
| Explained things with clarity | | | | |
| Maintained eye contact with students | | | | |
| Listened to students questions and comments | | | | |
| Defined unfamiliar terms, concepts and principles | | | | |
| Presented examples to clarify points | | | | |
| Related new ideas to familiar concepts | | | | |

**Comments:**

| ***Teacher-Student Interaction*** | *Could Improve* | *Acceptable* | *Excellent* | *Not Observed* |
|---|---|---|---|---|
| Encourage student questions | | | | |
| Encourage student discussion | | | | |
| Maintained student attention | | | | |
| Monitor students' progress | | | | |
| Gave satisfactory answers to questions | | | | |
| Paced lesson to allow time for note taking | | | | |
| Encouraged students to answer difficult questions | | | | |
| Asked probing questions when necessary | | | | |
| Restated questions and answers when necessary | | | | |

**Comments:**

| ***Teaching methods*** | *Could Improve* | *Acceptable* | *Excellent* | *Not Observed* |
|---|---|---|---|---|
| Lecture | | | | |
| Class discussion | | | | |
| Cooperative learning | | | | |
| Teacher-led discussion | | | | |
| Teacher-student shared responsibility (seminar, discussion) | | | | |
| Student computer use | | | | |
| Student presentations | | | | |
| Hands-on practice | | | | |
| Seat work (e.g., worksheets, textbook readings) | | | | |
| Experiential learning (labs, fieldwork, internships, etc.) | | | | |

**Comment:**

| ***Selection and use of teaching tools*** | *Could Improve* | *Acceptable* | *Excellent* | *Not Observed* |
|---|---|---|---|---|
| Organization of the classroom whiteboard | | | | |
| Provide various teaching tools | | | | |
| Films, websites, and other audiovisual materials | | | | |
| Employs electronic technology tools (i.e.computer, video, overheads) | | | | |
| Shared students to using the tools. | | | | |

**Comments:**

| ***Assessment*** | *Could Improve* | *Acceptable* | *Excellent* | *Not Observed* |
|---|---|---|---|---|
| Concern for the student assessment | | | | |
| Diversify the assessment methods ( oral, practical , writing) | | | | |
| Encourage student for self assessment | | | | |
| Correct the students' answers | | | | |

**Comments:**

# Appendix 8

## Teaching Plan of the Science Curriculum for Grade 6 Second term (2012/2013)

Ministry of Education
Science General Supervision

**<u>Teaching Plan of the Science Curriculum for Grade 6 Second term ( 2012/2013)</u>**

| Unit | Chapter | Lesson | Subjects | Class Periods | Month | Page No |
|---|---|---|---|---|---|---|
| One Life sciences | One Ecology | | Science & technology Exploratory activity ( Exploring Parts of Soil) + reading for science | 1 | February | |
| | | 1 | What Makes Up Eco system ? | 3 | | |
| | | 2 | How Do living Things Get Energy? | 2 | Mars +one period of April | |
| | | 3 | How Does Energy Move Through an Eco system? | 3 | | |
| | Two Living a Healthy Life | | Exploratory activity ( Exploring How Diseases Spread)+ mathematics in science | 1 | | |
| | | 1 | What Are Communicable Diseases? | 4 | | |
| | | 2 | What Are Non- Communicable diseases? | 3 | | |
| | | 3 | What Is a Healthy Life Style? | 4 | | |
| | | | Survey activity (Measuring Heart Rates) | 1 | April | |
| | | | Revision of ( unit1+perfprmance) + writing for science | 1 | | |
| Two Matter and Energy | One Investigating Motion | | Science & technology Exploratory activity ( Exploring Motion) + reading for science | 1 | | |
| | | 1 | How Is Motion Measured? | 1 | | |
| | | 2 | What Affects Motion ? | 2 | | |
| | | | Survey activity (Investigating Force Used to Move Objects) | 1 | | |
| | | 3 | How Does Gravity Affect Motion? | 2 | | |
| | | | Survey activity (Investigating Friction) | 1 | | |
| | | 4 | How Does Friction Affect Motion? | 2 | | |
| | | | Experimental activity (Experimenting With Balloon) | 1 | | |
| | Two Forms Of Energy | | Science & technology Exploratory activity ( Modeling Roller Coaster Motion) + reading for science | 1 | | |
| | | 1 | How Are Kinetic and Potential Energy Related? | 1 | | |
| | | | Survey activity (Investigating Potential Energy) | 1 | May | |
| | | 2 | What forms Of Energy Do You Use? | 1 | | |
| | Three Electrical Energy | | Exploratory activity ( Exploring Electric Charges) + Mathematic in science | 1 | | |
| | | 1 | How Does Electricity Move? | 1 | | |
| | | | Survey activity (Testing Electrical Conductivity) | 1 | | |
| | | 2 | How Is Electricity Used in the Home? | 1 | | |
| | | | Survey activity (Making a Dimmer Switch) | 1 | | |
| | | | Revision of ( unit2+perfprmance) + writing for science | 1 | | |
| Three Discovering Earth and Space | One Climate | | Science & technology Exploratory activity ( Exploring How Sunlight Moves Water) + Mathematic in science | 1 | | |
| | | 1 | How Does the Sun Affect Climate ? | 2 | | |
| | | | Survey activity (Investigating How a Greenhouse Works | 1 | | |
| | | 2 | What Makes Climate Change? | 1 | | |
| | Two Astronomy | | Exploratory activity ( Making a model of the Solar System) + Mathematic in science | 1 | | |
| | | 1 | What Makes Up the Solar System? | 1 | | |
| | | | Revision of ( unit3+perfprmance) + writing for science | 1 | | |
| | | | Total Periods | 52 | | |

# Appendix 9

## Teaching Plan of the Science Curriculum for Grade 7
## Second term (2012/2013)

Ministry of Education
Science General Supervision

**Teaching Plan of the Science Curriculum for Grade 7 First term ( 2012/2013)**

| Unit | Chapter | Lesson | Subjects | Class Periods | Month | Page No |
|---|---|---|---|---|---|---|
| | Preface | | Science Exploration | 2 | September + one period of October | |
| one Living Things | One Cells and Living Things | (1-1) | Cell Theory | 1 | | |
| | | (2-1) | Parts of Cell | 3 | | |
| | | (3-1) | Organization of living things | 1 | October + one period of November | |
| | | | Practical Activity(1-1) Examination of Organization of living things | 1 | | |
| | Two Cell Processes | (1-2) | Movement of substances | 3 | | |
| | | (2-2) | Energy Processes | 3 | | |
| | | (3-2) | Cell Growth and Division + Exploration | 3 | | |
| | | | Practical Activity(2-1) Examination Phases of Mitosis | 1 | | |
| | | | The First Period review questions( chapter 1&2) | 1 | | |
| Two Matter and Energy | First Properties of Matter | (1-1) | Matter | 2 | November + two period of December | |
| | | (2-1) | Phases of Matter | 3 | | |
| | | (3-1) | Changes in Matter | 1 | | |
| | | | Practical Activity(1-2) Exploration the Chemical Changes | 1 | | |
| | Two Atoms Elements Compounds &Mixtures | (1-2) | Structure of the Atom | 3 | | |
| | | (2-2) | Elements | 2 | | |
| | | (3-2) | Compounds | 2 | | |
| | | (4-2) | Mixtures | 1 | | |
| | Three Introduction to Periodic Table | (1-3) | The Modern Periodic Table | 4 | December+ two period of January | |
| | | | Practical Activity(2-2) Exploration directions of the Periodic Table | 1 | | |
| | | (2-3) | Metals | 4 | | |
| | | (3-3) | Non metals and Metalloids | 3 | | |
| | | | The Second Period review questions( chapter 1-2-3) | 1 | | |
| Three Earth Exploration | One Topography and Geography | (1-1) | Earth's Surface | 2 | | |
| | | (2-1) | Mapping the Earth | 1 | | |
| | Two Structure of the Earth | (1-2) | Zones of the Earth | 3 | January | |
| | | | Practical Activity(1-3) Kinetic Cover model | 1 | | |
| | | (2-2) | Studying the Earths Interior | 1 | | |
| | | | The Third Period review questions( chapter 1&2) | 1 | | |
| | | | Total Period | 56 | | |

# Appendix 10

Certificate of Ethical Research Approval

STUDENT HIGHER-LEVEL RESEARCH
DISSERTATION/THESIS

UNIVERSITY OF EXETER

Graduate School of Education

## Certificate of ethical research approval

**DISSERTATION/THESIS**

To activate this certificate you need to first sign it yourself, and then have it signed by your supervisor and finally by the Chair of the School's Ethics Committee.

For further information on ethical educational research access the guidelines on the BERA web site: http://www.bera.ac.uk/publications/guidelines/ and view the School's statement on the GSE student access on-line documents.

**READ THIS FORM CAREFULLY AND THEN COMPLETE IT ON YOUR COMPUTER** (the form will expand to contain the text you enter). **DO NOT COMPLETE BY HAND**

**Your name:** Ahmad Alshammari

**Your student no:** 570028765

**Return address for this certificate:** 25 Luxborough tower, Luxborough street, London, W1u 5bp

**Degree/Programme of Study:** PhD of Education

**Project Supervisor(s):** Nigel Skinner and Nasser Mansour

**Your email address:** asa218@exeter.ac.uk **and ahmad-shallal@hotmail.com**

**Tel:** 07552885649

**I hereby certify that I will abide by the details given overleaf and that I undertake in my dissertation / thesis** (delete whichever is inappropriate) **to respect the dignity and privacy of those participating in this research.**

**I confirm that if my research should change radically, I will complete a further form.**

**Signed:**.................................................. **date:** 28..10..2011

***NB*** *For Masters dissertations, which are marked blind, this first page must* ***not be included*** *in your work. It can be kept for your records.*

Chair of the School's Ethics Committee
updated: April 2011

**This form should now be printed out**, *signed by you on the first page and sent to your supervisor to sign. Your supervisor will forward this document to the School's* ***Research Support Office*** *for the Chair of the School's Ethics Committee to countersign. A unique approval reference will be added and this certificate will be returned to you to be included at the back of your dissertation/thesis.*

***N.B.*** *You should not start the fieldwork part of the project until you have the signature of your supervisor*

**This project has been approved for the period:** January 2012 **until:** December 2012

**By** (above mentioned supervisor's signature):.................................................**date:** 28/10/11
Nasser Mansour

***N.B. To Supervisor:*** *Please ensure that ethical issues are addressed annually in your report and if any changes in the research occur a further form is completed.*

**GSE unique approval reference:**..........D/11/12/7..........

**Signed:**....Salah Troudi....................................**date:**....3/11/2011
Chair of the School's Ethics Committee

This form is available from http://education.exeter.ac.uk/students/

Chair of the School's Ethics Committee
updated: April 2011

# Appendix 11

## Interim Consent from the Public Authority for Applied Education and Training

THE PUBLIC AUTHORITY
FOR APPLIED EDUCATION & TRAINING

الهيئة العامة
للتعليم التطبيقي والتدريب

50th Anniversary of the Issuance of the Constitution of the State of Kuwait
1962 - 2012

الإشارة :

التاريخ : 9 ابريل ٢٠١٢

**شهادة لمن يهمه الأمر**

تشهد الهيئة العامة للتعليم التطبيقي والتدريب بأن السيد / أحمد شلال الشمري موفد في بعثة دراسية للحصول على درجتي الماجستير والدكتوراه في مناهج وطرق تدريس/علوم من جامعة Exeter بالمملكة المتحدة اعتباراً من ٢٠٠٧/٩/١ ولمدة ست سنوات.

وقد أعطيت له هذه الشهادة - بناء على طلبه – وذلك لتقديمها لوزارة التربية -منطقة التعليمية العاصمة – منطقة التعليمية الفروانية – منطقة التعليمية الجهراء – منطقة حولي التعليمية – منطقة الأحمدي التعليمية - منطقة مبارك الكبير التعليمية وذلك لتسهيل الاستفادة من وسائل التعليم وجمع المعلومات دون أدنى مسئولية على الهيئة فيما يتعلق بحقوق الغير، مع الإحاطة بأن صلاحية هذه الشهادة ثلاثة شهور فقط من تاريخه.

ع / المدير العام

حصة صالح الحسن النجار
مدير إدارة البعثات والعلاقات الثقافية

State of Kuwait — Half Dinar — A06896493

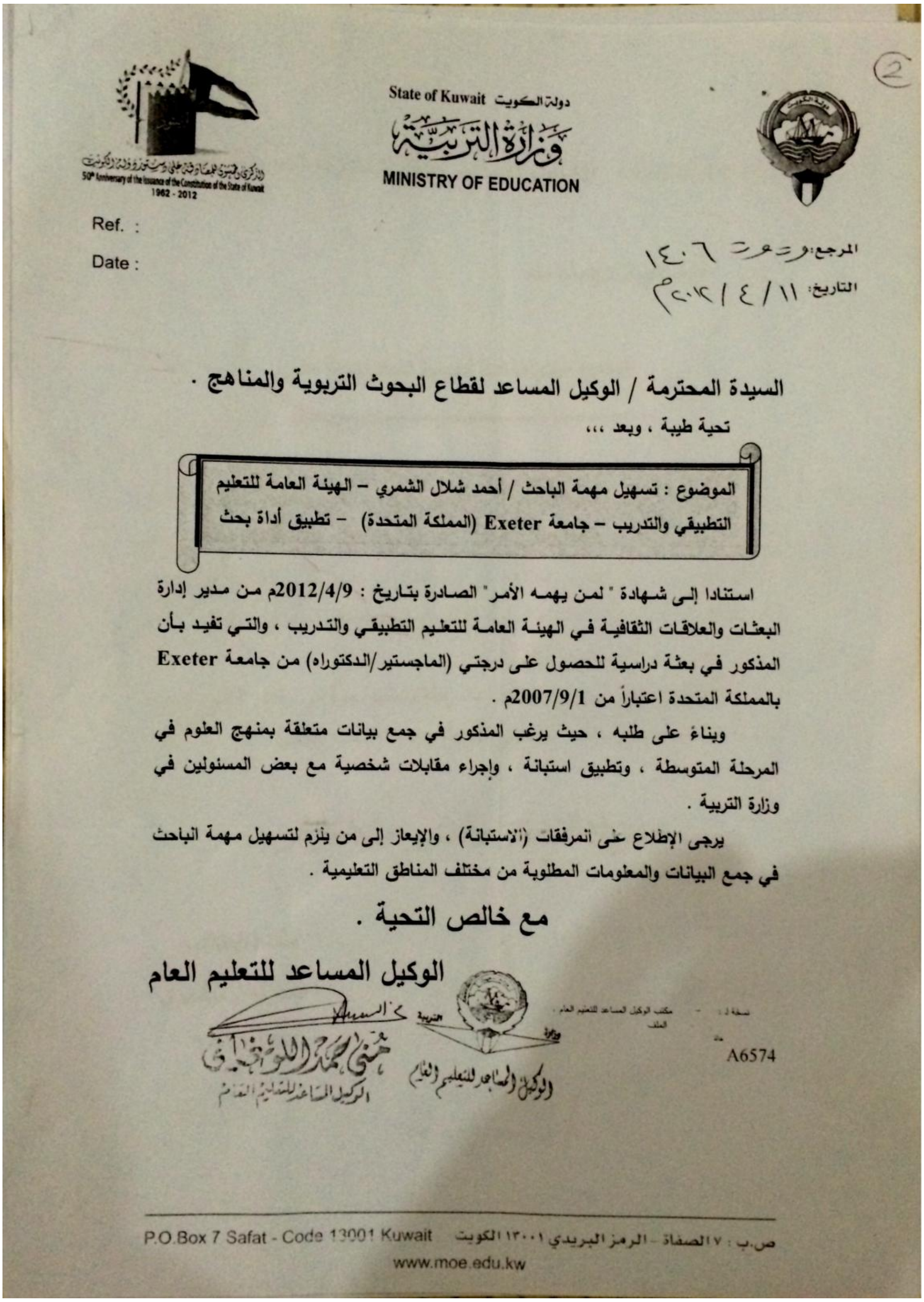
State of Kuwait — Half Dinar — A06896098

العديلية قطعة 4 مقابل الدائري الثالث - ص ب 23167 الصفاة (13092) الكويت بدالة: (1806611) فاكس: 22528915

P.O. Box 23167 - Safat, (13092) Kuwait - Tel. : 1806611 - IDILIYA Block 4 - Opposite The Third Ring Road

# Appendix 12

Interim Consent from the Ministry of Education



State of Kuwait دولة الكويت

وزارة التربية

MINISTRY OF EDUCATION

الذكرى الخمسون لإصدار دستور دولة الكويت
50th Anniversary of the Issuance of the Constitution of the State of Kuwait
1962 - 2012

Ref. :

Date :

المرجع: [illegible] ١٤٠٦

التاريخ: ١١ / ٤ / ٢٠١٢م

السيدة المحترمة / الوكيل المساعد لقطاع البحوث التربوية والمناهج .

تحية طيبة ، وبعد ،،،

الموضوع : تسهيل مهمة الباحث / أحمد شلال الشمري – الهيئة العامة للتعليم التطبيقي والتدريب – جامعة Exeter (المملكة المتحدة) – تطبيق أداة بحث

استنادا إلى شهادة " لمن يهمه الأمر" الصادرة بتاريخ : 2012/4/9م من مدير إدارة البعثات والعلاقات الثقافية في الهيئة العامة للتعليم التطبيقي والتدريب ، والتي تفيد بأن المذكور في بعثة دراسية للحصول على درجتي (الماجستير/الدكتوراه) من جامعة Exeter بالمملكة المتحدة اعتباراً من 2007/9/1م .

وبناءً على طلبه ، حيث يرغب المذكور في جمع بيانات متعلقة بمنهج العلوم في المرحلة المتوسطة ، وتطبيق استبانة ، وإجراء مقابلات شخصية مع بعض المسئولين في وزارة التربية .

يرجى الإطلاع على المرفقات (الاستبانة) ، والإيعاز إلى من يلزم لتسهيل مهمة الباحث في جمع البيانات والمعلومات المطلوبة من مختلف المناطق التعليمية .

مع خالص التحية .

الوكيل المساعد للتعليم العام

منى محمد اللوغاني
الوكيل المساعد للتعليم العام

الوكيل المساعد للتعليم العام

نسخة ل: - مكتب الوكيل المساعد للتعليم العام .
الملف

A6574

P.O.Box 7 Safat - Code 13001 Kuwait ص.ب : ٧ الصفاة - الرمز البريدي ١٣٠٠١ الكويت

www.moe.edu.kw

# Appendix 13

## Consent Form of Teachers, Students and Reformers

I have been fully informed about the aims and purposes of the project. I authorise the researchers to use my answers for the purposes of the research project.

I understand that:

A. There is no compulsion for me to participate in this research project and, if I do choose to participate, I may at any stage withdraw my participation without explanation, reason or prejudice.

B. I have the right to refuse permission for the publication of any information about me.

C. Any information which I give will be used solely for the purposes of this research project, which may include publications.

D. If applicable, the information, which I give, may be shared between any of the other researcher(s) participating in this project in an anonymised form.

E. All information I give will be treated as confidential.

F. The researcher(s) will make every effort to preserve my anonymity.

G. My name will be kept confidential by using a numeric code.

...........................……………….. ...............................

(Signature of participant) (Date)

One copy of this form will be kept by the participant; a second copy will be kept by the researcher(s).

If you have any concerns about the project that you would like to discuss, please contact:

***Kuwait phone number: 00965- 66651191. UK phone number: 0044-7552885649***

***OR by Email: ahmad-shallal@hotmail.com***

# Appendix 14

## Consent Form for the Parents of Students

I have been fully informed about the aims and purposes of the project. I authorise the researchers to use ***my Son/daughter*** answers for the purposes of the research project.

I understand that:

A. There is no compulsion for ***my Son/daughter*** to participate in this research project and, if he/she do choose to participate, ***my Son/daughter*** may withdraw at any stage without explanation, reason or prejudice.

B. I have the right to refuse permission for the publication of any information about ***my Son/daughter***.

C. Any information which ***my Son/daughter*** give will be used solely for the purposes of this research project, which may include publications

D. If applicable, the information, which ***my Son/daughter*** give, may be shared between any of the other researcher(s) participating in this project in an anonymised form.

E. All information of ***my Son/daughter*** give will be treated as confidential.

F. The researcher(s) will make every effort to preserve ***my Son/daughter*** anonymity.

G. ***My Son/daughter*** name will be kept confidential by using a numeric code.

H. ***My Son/daughter*** will be asked to sign a similar consent form.

...........................………………..                                        ..................................

(Signature of parent)                                        (Date)

One copy of this form will be kept by the participant; a second copy will be kept by the researcher(s). If you have any concerns about the project that you would like to discuss, please contact: **Kuwait phone number: 00965- 66651191. UK phone number: 0044-7552885649. Email: ahmad-shallal@hotmail.com**

# Appendix 15

## Tukey Test Results of Teacher Experience

**Multiple Comparisons**

| Dependent Variable | | (I) Teaching Experience | (J) Teaching Experience | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Lower Bound | Upper Bound |
| Curriculum contents | Tukey HSD | 2-5 yrs | 6-10 yrs | .43643* | .08331 | .000 | .2078 | .6651 |
| | | | 11-15 yrs | .49383* | .09905 | .000 | .2220 | .7657 |
| | | | 16-20 yrs | .31818 | .11667 | .052 | -.0020- | .6384 |
| | | | > 20 yrs | .12835 | .12231 | .832 | -.2073- | .4640 |
| | | 6-10 yrs | 2-5 yrs | -.43643-* | .08331 | .000 | -.6651- | -.2078- |
| | | | 11-15 yrs | .05740 | .09525 | .975 | -.2040- | .3188 |
| | | | 16-20 yrs | -.11825- | .11346 | .836 | -.4296- | .1931 |
| | | | > 20 yrs | -.30808- | .11926 | .076 | -.6354- | .0192 |
| | | 11-15 yrs | 2-5 yrs | -.49383-* | .09905 | .000 | -.7657- | -.2220- |
| | | | 6-10 yrs | -.05740- | .09525 | .975 | -.3188- | .2040 |
| | | | 16-20 yrs | -.17565- | .12548 | .628 | -.5200- | .1687 |
| | | | > 20 yrs | -.36547-* | .13074 | .044 | -.7243- | -.0067- |
| | | 16-20 yrs | 2-5 yrs | -.31818- | .11667 | .052 | -.6384- | .0020 |
| | | | 6-10 yrs | .11825 | .11346 | .836 | -.1931- | .4296 |
| | | | 11-15 yrs | .17565 | .12548 | .628 | -.1687- | .5200 |
| | | | > 20 yrs | -.18983- | .14455 | .683 | -.5865- | .2069 |
| | | > 20 yrs | 2-5 yrs | -.12835- | .12231 | .832 | -.4640- | .2073 |
| | | | 6-10 yrs | .30808 | .11926 | .076 | -.0192- | .6354 |
| | | | 11-15 yrs | .36547* | .13074 | .044 | .0067 | .7243 |
| | | | 16-20 yrs | .18983 | .14455 | .683 | -.2069- | .5865 |
| Curriculum objectives | Tukey HSD | 2-5 yrs | 6-10 yrs | .45317* | .10201 | .000 | .1732 | .7331 |
| | | | 11-15 yrs | .50265* | .12102 | .000 | .1705 | .8348 |
| | | | 16-20 yrs | .29720 | .14104 | .220 | -.0899- | .6843 |
| | | | > 20 yrs | .24578 | .14581 | .444 | -.1544- | .6459 |
| | | 6-10 yrs | 2-5 yrs | -.45317-* | .10201 | .000 | -.7331- | -.1732- |
| | | | 11-15 yrs | .04948 | .11657 | .993 | -.2704- | .3694 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 16-20 yrs | -.15597- | .13724 | .787 | -.5326- | .2207 |
| | | | > 20 yrs | -.20739- | .14214 | .590 | -.5975- | .1827 |
| | | 11-15 yrs | 2-5 yrs | -.50265-* | .12102 | .000 | -.8348- | -.1705- |
| | | | 6-10 yrs | -.04948- | .11657 | .993 | -.3694- | .2704 |
| | | | 16-20 yrs | -.20545- | .15190 | .659 | -.6223- | .2114 |
| | | | > 20 yrs | -.25687- | .15635 | .471 | -.6860- | .1722 |
| | | 16-20 yrs | 2-5 yrs | -.29720- | .14104 | .220 | -.6843- | .0899 |
| | | | 6-10 yrs | .15597 | .13724 | .787 | -.2207- | .5326 |
| | | | 11-15 yrs | .20545 | .15190 | .659 | -.2114- | .6223 |
| | | | > 20 yrs | -.05142- | .17231 | .998 | -.5243- | .4215 |
| | | > 20 yrs | 2-5 yrs | -.24578- | .14581 | .444 | -.6459- | .1544 |
| | | | 6-10 yrs | .20739 | .14214 | .590 | -.1827- | .5975 |
| | | | 11-15 yrs | .25687 | .15635 | .471 | -.1722- | .6860 |
| | | | 16-20 yrs | .05142 | .17231 | .998 | -.4215- | .5243 |
| **Student assessment system** | Tukey HSD | 2-5 yrs | 6-10 yrs | .47410* | .11771 | .001 | .1511 | .7971 |
| | | | 11-15 yrs | .61602* | .14070 | .000 | .2299 | 1.0021 |
| | | | 16-20 yrs | .28650 | .16386 | .406 | -.1632- | .7362 |
| | | | > 20 yrs | .26895 | .16939 | .506 | -.1959- | .7338 |
| | | 6-10 yrs | 2-5 yrs | -.47410-* | .11771 | .001 | -.7971- | -.1511- |
| | | | 11-15 yrs | .14192 | .13433 | .829 | -.2267- | .5106 |
| | | | 16-20 yrs | -.18760- | .15843 | .761 | -.6224- | .2472 |
| | | | > 20 yrs | -.20516- | .16415 | .722 | -.6556- | .2453 |
| | | 11-15 yrs | 2-5 yrs | -.61602-* | .14070 | .000 | -1.0021- | -.2299- |
| | | | 6-10 yrs | -.14192- | .13433 | .829 | -.5106- | .2267 |
| | | | 16-20 yrs | -.32952- | .17618 | .336 | -.8130- | .1540 |
| | | | > 20 yrs | -.34707- | .18134 | .312 | -.8447- | .1506 |
| | | 16-20 yrs | 2-5 yrs | -.28650- | .16386 | .406 | -.7362- | .1632 |
| | | | 6-10 yrs | .18760 | .15843 | .761 | -.2472- | .6224 |
| | | | 11-15 yrs | .32952 | .17618 | .336 | -.1540- | .8130 |
| | | | > 20 yrs | -.01755- | .19985 | 1.000 | -.5660- | .5309 |
| | | > 20 yrs | 2-5 yrs | -.26895- | .16939 | .506 | -.7338- | .1959 |
| | | | 6-10 yrs | .20516 | .16415 | .722 | -.2453- | .6556 |
| | | | 11-15 yrs | .34707 | .18134 | .312 | -.1506- | .8447 |
| | | | 16-20 yrs | .01755 | .19985 | 1.000 | -.5309- | .5660 |
| **Teacher objectives** | Tukey HSD | 2-5 yrs | 6-10 yrs | .08318 | .07316 | .787 | -.1176- | .2840 |
| | | | 11-15 yrs | .17240 | .08736 | .281 | -.0673- | .4121 |
| | | | 16-20 yrs | -.00117- | .10180 | 1.000 | -.2805- | .2782 |
| | | | > 20 yrs | .17499 | .10525 | .459 | -.1138- | .4638 |
| | | 6-10 yrs | 2-5 yrs | -.08318- | .07316 | .787 | -.2840- | .1176 |
| | | | 11-15 yrs | .08922 | .08374 | .824 | -.1406- | .3190 |
| | | | 16-20 yrs | -.08435- | .09871 | .913 | -.3552- | .1865 |
| | | | > 20 yrs | .09180 | .10226 | .898 | -.1888- | .3724 |
| | | 11-15 yrs | 2-5 yrs | -.17240- | .08736 | .281 | -.4121- | .0673 |
| | | | 6-10 yrs | -.08922- | .08374 | .824 | -.3190- | .1406 |
| | | | 16-20 yrs | -.17357- | .10965 | .510 | -.4745- | .1273 |
| | | | > 20 yrs | .00259 | .11286 | 1.000 | -.3071- | .3123 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 16-20 yrs | 2-5 yrs | .00117 | .10180 | 1.000 | -.2782- | .2805 |
| | | | 6-10 yrs | .08435 | .09871 | .913 | -.1865- | .3552 |
| | | | 11-15 yrs | .17357 | .10965 | .510 | -.1273- | .4745 |
| | | | > 20 yrs | .17615 | .12438 | .618 | -.1652- | .5175 |
| | | > 20 yrs | 2-5 yrs | -.17499- | .10525 | .459 | -.4638- | .1138 |
| | | | 6-10 yrs | -.09180- | .10226 | .898 | -.3724- | .1888 |
| | | | 11-15 yrs | -.00259- | .11286 | 1.000 | -.3123- | .3071 |
| | | | 16-20 yrs | -.17615- | .12438 | .618 | -.5175- | .1652 |
| **Ministry of Education support** | Tukey HSD | 2-5 yrs | 6-10 yrs | .45095* | .11420 | .001 | .1376 | .7644 |
| | | | 11-15 yrs | .51243* | .13608 | .002 | .1390 | .8859 |
| | | | 16-20 yrs | .12899 | .15858 | .926 | -.3062- | .5642 |
| | | | > 20 yrs | .03203 | .16395 | 1.000 | -.4179- | .4819 |
| | | 6-10 yrs | 2-5 yrs | -.45095-* | .11420 | .001 | -.7644- | -.1376- |
| | | | 11-15 yrs | .06148 | .13064 | .990 | -.2970- | .4200 |
| | | | 16-20 yrs | -.32196- | .15394 | .226 | -.7444- | .1005 |
| | | | > 20 yrs | -.41892- | .15947 | .068 | -.8565- | .0187 |
| | | 11-15 yrs | 2-5 yrs | -.51243-* | .13608 | .002 | -.8859- | -.1390- |
| | | | 6-10 yrs | -.06148- | .13064 | .990 | -.4200- | .2970 |
| | | | 16-20 yrs | -.38344- | .17080 | .166 | -.8522- | .0853 |
| | | | > 20 yrs | -.48041- | .17580 | .052 | -.9628- | .0020 |
| | | 16-20 yrs | 2-5 yrs | -.12899- | .15858 | .926 | -.5642- | .3062 |
| | | | 6-10 yrs | .32196 | .15394 | .226 | -.1005- | .7444 |
| | | | 11-15 yrs | .38344 | .17080 | .166 | -.0853- | .8522 |
| | | | > 20 yrs | -.09696- | .19374 | .987 | -.6286- | .4347 |
| | | > 20 yrs | 2-5 yrs | -.03203- | .16395 | 1.000 | -.4819- | .4179 |
| | | | 6-10 yrs | .41892 | .15947 | .068 | -.0187- | .8565 |
| | | | 11-15 yrs | .48041 | .17580 | .052 | -.0020- | .9628 |
| | | | 16-20 yrs | .09696 | .19374 | .987 | -.4347- | .6286 |
| **School support** | Tukey HSD | 2-5 yrs | 6-10 yrs | .21714* | .07705 | .041 | .0057 | .4286 |
| | | | 11-15 yrs | .27037* | .09153 | .028 | .0192 | .5216 |
| | | | 16-20 yrs | .12941 | .10647 | .742 | -.1628- | .4216 |
| | | | > 20 yrs | .08387 | .11003 | .941 | -.2181- | .3859 |
| | | 6-10 yrs | 2-5 yrs | -.21714-* | .07705 | .041 | -.4286- | -.0057- |
| | | | 11-15 yrs | .05323 | .08725 | .973 | -.1862- | .2927 |
| | | | 16-20 yrs | -.08773- | .10281 | .913 | -.3699- | .1944 |
| | | | > 20 yrs | -.13327- | .10650 | .721 | -.4255- | .1590 |
| | | 11-15 yrs | 2-5 yrs | -.27037-* | .09153 | .028 | -.5216- | -.0192- |
| | | | 6-10 yrs | -.05323- | .08725 | .973 | -.2927- | .1862 |
| | | | 16-20 yrs | -.14096- | .11406 | .730 | -.4540- | .1721 |
| | | | > 20 yrs | -.18650- | .11740 | .506 | -.5087- | .1357 |
| | | 16-20 yrs | 2-5 yrs | -.12941- | .10647 | .742 | -.4216- | .1628 |
| | | | 6-10 yrs | .08773 | .10281 | .913 | -.1944- | .3699 |
| | | | 11-15 yrs | .14096 | .11406 | .730 | -.1721- | .4540 |
| | | | > 20 yrs | -.04554- | .12938 | .997 | -.4006- | .3095 |
| | | > 20 yrs | 2-5 yrs | -.08387- | .11003 | .941 | -.3859- | .2181 |
| | | | 6-10 yrs | .13327 | .10650 | .721 | -.1590- | .4255 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 11-15 yrs | .18650 | .11740 | .506 | -.1357- | .5087 |
| | | | 16-20 yrs | .04554 | .12938 | .997 | -.3095- | .4006 |
| challenges | Tukey HSD | 2-5 yrs | 6-10 yrs | .16546* | .05238 | .015 | .0217 | .3092 |
| | | | 11-15 yrs | .19137* | .06261 | .020 | .0196 | .3632 |
| | | | 16-20 yrs | .14453 | .07292 | .277 | -.0556- | .3446 |
| | | | > 20 yrs | -.03154- | .07538 | .994 | -.2384- | .1753 |
| | | 6-10 yrs | 2-5 yrs | -.16546-* | .05238 | .015 | -.3092- | -.0217- |
| | | | 11-15 yrs | .02591 | .05978 | .993 | -.1381- | .1900 |
| | | | 16-20 yrs | -.02093- | .07050 | .998 | -.2144- | .1725 |
| | | | > 20 yrs | -.19699- | .07304 | .057 | -.3974- | .0034 |
| | | 11-15 yrs | 2-5 yrs | -.19137-* | .06261 | .020 | -.3632- | -.0196- |
| | | | 6-10 yrs | -.02591- | .05978 | .993 | -.1900- | .1381 |
| | | | 16-20 yrs | -.04684- | .07840 | .975 | -.2620- | .1683 |
| | | | > 20 yrs | -.22290-* | .08069 | .048 | -.4443- | -.0015- |
| | | 16-20 yrs | 2-5 yrs | -.14453- | .07292 | .277 | -.3446- | .0556 |
| | | | 6-10 yrs | .02093 | .07050 | .998 | -.1725- | .2144 |
| | | | 11-15 yrs | .04684 | .07840 | .975 | -.1683- | .2620 |
| | | | > 20 yrs | -.17606- | .08893 | .278 | -.4201- | .0680 |
| | | > 20 yrs | 2-5 yrs | .03154 | .07538 | .994 | -.1753- | .2384 |
| | | | 6-10 yrs | .19699 | .07304 | .057 | -.0034- | .3974 |
| | | | 11-15 yrs | .22290* | .08069 | .048 | .0015 | .4443 |
| | | | 16-20 yrs | .17606 | .08893 | .278 | -.0680- | .4201 |

*. The mean difference is significant at the 0.05 level.

# Appendix 16

## Tukey Test Results of Teacher Specialisation

**Multiple Comparisons**

| Dependent Variable | | (I) Specialty | (J) Specialty | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Lower Bound | Upper Bound |
| **Curriculum contents** | Tukey HSD | Science Education | General Science | -.02417- | .10115 | 1.000 | -.3143- | .2660 |
| | | | Physics | -.67027-* | .12214 | .000 | -1.0206- | -.3199- |
| | | | Chemical | -.82158-* | .10994 | .000 | -1.1369- | -.5062- |
| | | | Biology | -.72436-* | .10994 | .000 | -1.0397- | -.4090- |
| | | | Geology | -.65954-* | .17327 | .002 | -1.1566- | -.1625- |
| | | General Science | Science Education | .02417 | .10115 | 1.000 | -.2660- | .3143 |
| | | | Physics | -.64610-* | .15000 | .000 | -1.0764- | -.2158- |
| | | | Chemical | -.79741-* | .14024 | .000 | -1.1997- | -.3951- |
| | | | Biology | -.70019-* | .14024 | .000 | -1.1025- | -.2979- |
| | | | Geology | -.63538-* | .19392 | .015 | -1.1916- | -.0791- |
| | | Physics | Science Education | .67027* | .12214 | .000 | .3199 | 1.0206 |
| | | | General Science | .64610* | .15000 | .000 | .2158 | 1.0764 |
| | | | Chemical | -.15132- | .15606 | .927 | -.5990- | .2964 |
| | | | Biology | -.05409- | .15606 | .999 | -.5018- | .3936 |
| | | | Geology | .01072 | .20565 | 1.000 | -.5792- | .6006 |
| | | Chemical | Science Education | .82158* | .10994 | .000 | .5062 | 1.1369 |
| | | | General Science | .79741* | .14024 | .000 | .3951 | 1.1997 |
| | | | Physics | .15132 | .15606 | .927 | -.2964- | .5990 |
| | | | Biology | .09722 | .14671 | .986 | -.3236- | .5181 |
| | | | Geology | .16204 | .19864 | .965 | -.4078- | .7319 |
| | | Biology | Science Education | .72436* | .10994 | .000 | .4090 | 1.0397 |
| | | | General Science | .70019* | .14024 | .000 | .2979 | 1.1025 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Physics | .05409 | .15606 | .999 | -.3936- | .5018 |
| | | | Chemical | -.09722- | .14671 | .986 | -.5181- | .3236 |
| | | | Geology | .06481 | .19864 | 1.000 | -.5050- | .6346 |
| | | Geology | Science Education | .65954* | .17327 | .002 | .1625 | 1.1566 |
| | | | General Science | .63538* | .19392 | .015 | .0791 | 1.1916 |
| | | | Physics | -.01072- | .20565 | 1.000 | -.6006- | .5792 |
| | | | Chemical | -.16204- | .19864 | .965 | -.7319- | .4078 |
| | | | Biology | -.06481- | .19864 | 1.000 | -.6346- | .5050 |
| **Curriculum objectives** | Tukey HSD | Science Education | General Science | -.02251- | .12167 | 1.000 | -.3715- | .3265 |
| | | | Physics | -.87786-* | .15121 | .000 | -1.3116- | -.4441- |
| | | | Chemical | -.85589-* | .13871 | .000 | -1.2538- | -.4580- |
| | | | Biology | -.71821-* | .13611 | .000 | -1.1086- | -.3278- |
| | | | Geology | -.91518-* | .19496 | .000 | -1.4744- | -.3560- |
| | | General Science | Science Education | .02251 | .12167 | 1.000 | -.3265- | .3715 |
| | | | Physics | -.85535-* | .18327 | .000 | -1.3810- | -.3296- |
| | | | Chemical | -.83338-* | .17311 | .000 | -1.3299- | -.3368- |
| | | | Biology | -.69570-* | .17102 | .001 | -1.1863- | -.2051- |
| | | | Geology | -.89267-* | .22075 | .001 | -1.5259- | -.2594- |
| | | Physics | Science Education | .87786* | .15121 | .000 | .4441 | 1.3116 |
| | | | General Science | .85535* | .18327 | .000 | .3296 | 1.3810 |
| | | | Chemical | .02197 | .19500 | 1.000 | -.5374- | .5813 |
| | | | Biology | .15965 | .19316 | .962 | -.3944- | .7137 |
| | | | Geology | -.03732- | .23831 | 1.000 | -.7209- | .6463 |
| | | Chemical | Science Education | .85589* | .13871 | .000 | .4580 | 1.2538 |
| | | | General Science | .83338* | .17311 | .000 | .3368 | 1.3299 |
| | | | Physics | -.02197- | .19500 | 1.000 | -.5813- | .5374 |
| | | | Biology | .13768 | .18354 | .975 | -.3888- | .6642 |
| | | | Geology | -.05929- | .23059 | 1.000 | -.7207- | .6022 |
| | | Biology | Science Education | .71821* | .13611 | .000 | .3278 | 1.1086 |
| | | | General Science | .69570* | .17102 | .001 | .2051 | 1.1863 |
| | | | Physics | -.15965- | .19316 | .962 | -.7137- | .3944 |
| | | | Chemical | -.13768- | .18354 | .975 | -.6642- | .3888 |
| | | | Geology | -.19697- | .22903 | .956 | -.8539- | .4600 |
| | | Geology | Science Education | .91518* | .19496 | .000 | .3560 | 1.4744 |
| | | | General Science | .89267* | .22075 | .001 | .2594 | 1.5259 |
| | | | Physics | .03732 | .23831 | 1.000 | -.6463- | .7209 |
| | | | Chemical | .05929 | .23059 | 1.000 | -.6022- | .7207 |
| | | | Biology | .19697 | .22903 | .956 | -.4600- | .8539 |
| **Student assessment system** | Tukey HSD | Science Education | General Science | -.28590- | .14117 | .330 | -.6908- | .1190 |
| | | | Physics | -1.01256-* | .17551 | .000 | -1.5160- | -.5092- |
| | | | Chemical | -.96870-* | .15796 | .000 | -1.4218- | -.5156- |
| | | | Biology | -1.03120-* | .15796 | .000 | -1.4843- | -.5781- |
| | | | Geology | -.62021- | .22635 | .071 | -1.2695- | .0290 |
| | | General Science | Science Education | .28590 | .14117 | .330 | -.1190- | .6908 |
| | | | Physics | -.72666-* | .21287 | .009 | -1.3372- | -.1161- |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Chemical | -.68280-* | .19865 | .009 | -1.2526- | -.1130- |
| | | | Biology | -.74530-* | .19865 | .003 | -1.3151- | -.1755- |
| | | | Geology | -.33431- | .25641 | .783 | -1.0698- | .4011 |
| | | Physics | Science Education | 1.01256* | .17551 | .000 | .5092 | 1.5160 |
| | | | General Science | .72666* | .21287 | .009 | .1161 | 1.3372 |
| | | | Chemical | .04386 | .22436 | 1.000 | -.5996- | .6874 |
| | | | Biology | -.01864- | .22436 | 1.000 | -.6621- | .6249 |
| | | | Geology | .39234 | .27681 | .716 | -.4016- | 1.1863 |
| | | Chemical | Science Education | .96870* | .15796 | .000 | .5156 | 1.4218 |
| | | | General Science | .68280* | .19865 | .009 | .1130 | 1.2526 |
| | | | Physics | -.04386- | .22436 | 1.000 | -.6874- | .5996 |
| | | | Biology | -.06250- | .21091 | 1.000 | -.6674- | .5424 |
| | | | Geology | .34848 | .26602 | .779 | -.4145- | 1.1115 |
| | | Biology | Science Education | 1.03120* | .15796 | .000 | .5781 | 1.4843 |
| | | | General Science | .74530* | .19865 | .003 | .1755 | 1.3151 |
| | | | Physics | .01864 | .22436 | 1.000 | -.6249- | .6621 |
| | | | Chemical | .06250 | .21091 | 1.000 | -.5424- | .6674 |
| | | | Geology | .41098 | .26602 | .635 | -.3520- | 1.1740 |
| | | Geology | Science Education | .62021 | .22635 | .071 | -.0290- | 1.2695 |
| | | | General Science | .33431 | .25641 | .783 | -.4011- | 1.0698 |
| | | | Physics | -.39234- | .27681 | .716 | -1.1863- | .4016 |
| | | | Chemical | -.34848- | .26602 | .779 | -1.1115- | .4145 |
| | | | Biology | -.41098- | .26602 | .635 | -1.1740- | .3520 |
| **Teacher objectives** | Tukey HSD | Science Education | General Science | -.00571- | .09764 | 1.000 | -.2858- | .2744 |
| | | | Physics | -.16756- | .12138 | .739 | -.5157- | .1806 |
| | | | Chemical | -.04110- | .10925 | .999 | -.3545- | .2723 |
| | | | Biology | -.12443- | .10925 | .865 | -.4378- | .1889 |
| | | | Geology | .03340 | .15653 | 1.000 | -.4156- | .4824 |
| | | General Science | Science Education | .00571 | .09764 | 1.000 | -.2744- | .2858 |
| | | | Physics | -.16186- | .14719 | .881 | -.5840- | .2603 |
| | | | Chemical | -.03539- | .13735 | 1.000 | -.4294- | .3586 |
| | | | Biology | -.11873- | .13735 | .955 | -.5127- | .2752 |
| | | | Geology | .03910 | .17729 | 1.000 | -.4694- | .5476 |
| | | Physics | Science Education | .16756 | .12138 | .739 | -.1806- | .5157 |
| | | | General Science | .16186 | .14719 | .881 | -.2603- | .5840 |
| | | | Chemical | .12646 | .15513 | .965 | -.3185- | .5714 |
| | | | Biology | .04313 | .15513 | 1.000 | -.4018- | .4881 |
| | | | Geology | .20096 | .19139 | .900 | -.3480- | .7499 |
| | | Chemical | Science Education | .04110 | .10925 | .999 | -.2723- | .3545 |
| | | | General Science | .03539 | .13735 | 1.000 | -.3586- | .4294 |
| | | | Physics | -.12646- | .15513 | .965 | -.5714- | .3185 |
| | | | Biology | -.08333- | .14583 | .993 | -.5016- | .3350 |
| | | | Geology | .07449 | .18394 | .999 | -.4531- | .6021 |
| | | Biology | Science Education | .12443 | .10925 | .865 | -.1889- | .4378 |
| | | | General Science | .11873 | .13735 | .955 | -.2752- | .5127 |
| | | | Physics | -.04313- | .15513 | 1.000 | -.4881- | .4018 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Chemical | .08333 | .14583 | .993 | -.3350- | .5016 |
| | | | Geology | .15783 | .18394 | .956 | -.3698- | .6854 |
| | | Geology | Science Education | -.03340- | .15653 | 1.000 | -.4824- | .4156 |
| | | | General Science | -.03910- | .17729 | 1.000 | -.5476- | .4694 |
| | | | Physics | -.20096- | .19139 | .900 | -.7499- | .3480 |
| | | | Chemical | -.07449- | .18394 | .999 | -.6021- | .4531 |
| | | | Biology | -.15783- | .18394 | .956 | -.6854- | .3698 |
| **Ministry of Education support** | Tukey HSD | Science Education | General Science | -.04691- | .13892 | .999 | -.4454- | .3515 |
| | | | Physics | -.68018-* | .17269 | .001 | -1.1755- | -.1849- |
| | | | Chemical | -1.02755-* | .15543 | .000 | -1.4734- | -.5817- |
| | | | Biology | -.80255-* | .15543 | .000 | -1.2484- | -.3567- |
| | | | Geology | -.91846-* | .22269 | .001 | -1.5572- | -.2797- |
| | | General Science | Science Education | .04691 | .13892 | .999 | -.3515- | .4454 |
| | | | Physics | -.63328-* | .20940 | .032 | -1.2339- | -.0327- |
| | | | Chemical | -.98065-* | .19541 | .000 | -1.5411- | -.4202- |
| | | | Biology | -.75565-* | .19541 | .002 | -1.3161- | -.1952- |
| | | | Geology | -.87155-* | .25223 | .008 | -1.5950- | -.1481- |
| | | Physics | Science Education | .68018* | .17269 | .001 | .1849 | 1.1755 |
| | | | General Science | .63328* | .20940 | .032 | .0327 | 1.2339 |
| | | | Chemical | -.34737- | .22070 | .616 | -.9804- | .2857 |
| | | | Biology | -.12237- | .22070 | .994 | -.7554- | .5107 |
| | | | Geology | -.23828- | .27229 | .952 | -1.0193- | .5427 |
| | | Chemical | Science Education | 1.02755* | .15543 | .000 | .5817 | 1.4734 |
| | | | General Science | .98065* | .19541 | .000 | .4202 | 1.5411 |
| | | | Physics | .34737 | .22070 | .616 | -.2857- | .9804 |
| | | | Biology | .22500 | .20747 | .887 | -.3701- | .8201 |
| | | | Geology | .10909 | .26168 | .998 | -.6415- | .8597 |
| | | Biology | Science Education | .80255* | .15543 | .000 | .3567 | 1.2484 |
| | | | General Science | .75565* | .19541 | .002 | .1952 | 1.3161 |
| | | | Physics | .12237 | .22070 | .994 | -.5107- | .7554 |
| | | | Chemical | -.22500- | .20747 | .887 | -.8201- | .3701 |
| | | | Geology | -.11591- | .26168 | .998 | -.8665- | .6347 |
| | | Geology | Science Education | .91846* | .22269 | .001 | .2797 | 1.5572 |
| | | | General Science | .87155* | .25223 | .008 | .1481 | 1.5950 |
| | | | Physics | .23828 | .27229 | .952 | -.5427- | 1.0193 |
| | | | Chemical | -.10909- | .26168 | .998 | -.8597- | .6415 |
| | | | Biology | .11591 | .26168 | .998 | -.6347- | .8665 |
| **School support** | Tukey HSD | Science Education | General Science | -.12544- | .09275 | .755 | -.3915- | .1406 |
| | | | Physics | -.56042-* | .11530 | .000 | -.8912- | -.2297- |
| | | | Chemical | -.59583-* | .10789 | .000 | -.9053- | -.2863- |
| | | | Biology | -.41717-* | .10576 | .001 | -.7206- | -.1138- |
| | | | Geology | -.54673-* | .15557 | .007 | -.9930- | -.1005- |
| | | General Science | Science Education | .12544 | .09275 | .755 | -.1406- | .3915 |
| | | | Physics | -.43497-* | .13981 | .025 | -.8360- | -.0339- |
| | | | Chemical | -.47038-* | .13377 | .007 | -.8541- | -.0867- |
| | | | Biology | -.29173- | .13206 | .237 | -.6705- | .0871 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Geology | -.42129- | .17451 | .155 | -.9219- | .0793 |
| | | Physics | Science Education | .56042* | .11530 | .000 | .2297 | .8912 |
| | | | General Science | .43497* | .13981 | .025 | .0339 | .8360 |
| | | | Chemical | -.03541- | .15028 | 1.000 | -.4665- | .3957 |
| | | | Biology | .14325 | .14876 | .929 | -.2835- | .5700 |
| | | | Geology | .01368 | .18747 | 1.000 | -.5241- | .5515 |
| | | Chemical | Science Education | .59583* | .10789 | .000 | .2863 | .9053 |
| | | | General Science | .47038* | .13377 | .007 | .0867 | .8541 |
| | | | Physics | .03541 | .15028 | 1.000 | -.3957- | .4665 |
| | | | Biology | .17866 | .14310 | .812 | -.2318- | .5891 |
| | | | Geology | .04909 | .18301 | 1.000 | -.4759- | .5741 |
| | | Biology | Science Education | .41717* | .10576 | .001 | .1138 | .7206 |
| | | | General Science | .29173 | .13206 | .237 | -.0871- | .6705 |
| | | | Physics | -.14325- | .14876 | .929 | -.5700- | .2835 |
| | | | Chemical | -.17866- | .14310 | .812 | -.5891- | .2318 |
| | | | Geology | -.12957- | .18176 | .980 | -.6510- | .3918 |
| | | Geology | Science Education | .54673* | .15557 | .007 | .1005 | .9930 |
| | | | General Science | .42129 | .17451 | .155 | -.0793- | .9219 |
| | | | Physics | -.01368- | .18747 | 1.000 | -.5515- | .5241 |
| | | | Chemical | -.04909- | .18301 | 1.000 | -.5741- | .4759 |
| | | | Biology | .12957 | .18176 | .980 | -.3918- | .6510 |
| **challenges** | Tukey HSD | Science Education | General Science | .06351 | .06705 | .934 | -.1288- | .2558 |
| | | | Physics | -.32407-* | .08336 | .002 | -.5632- | -.0850- |
| | | | Chemical | -.27520-* | .07502 | .004 | -.4904- | -.0600- |
| | | | Biology | -.30496-* | .07502 | .001 | -.5201- | -.0898- |
| | | | Geology | -.18949- | .11248 | .543 | -.5121- | .1331 |
| | | General Science | Science Education | -.06351- | .06705 | .934 | -.2558- | .1288 |
| | | | Physics | -.38758-* | .10110 | .002 | -.6776- | -.0976- |
| | | | Chemical | -.33871-* | .09434 | .005 | -.6093- | -.0681- |
| | | | Biology | -.36847-* | .09434 | .002 | -.6391- | -.0979- |
| | | | Geology | -.25300- | .12619 | .342 | -.6150- | .1090 |
| | | Physics | Science Education | .32407* | .08336 | .002 | .0850 | .5632 |
| | | | General Science | .38758* | .10110 | .002 | .0976 | .6776 |
| | | | Chemical | .04887 | .10655 | .997 | -.2568- | .3545 |
| | | | Biology | .01911 | .10655 | 1.000 | -.2865- | .3247 |
| | | | Geology | .13459 | .13556 | .920 | -.2543- | .5234 |
| | | Chemical | Science Education | .27520* | .07502 | .004 | .0600 | .4904 |
| | | | General Science | .33871* | .09434 | .005 | .0681 | .6093 |
| | | | Physics | -.04887- | .10655 | .997 | -.3545- | .2568 |
| | | | Biology | -.02976- | .10017 | 1.000 | -.3171- | .2576 |
| | | | Geology | .08571 | .13060 | .986 | -.2889- | .4603 |
| | | Biology | Science Education | .30496* | .07502 | .001 | .0898 | .5201 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | General Science | .36847* | .09434 | .002 | .0979 | .6391 |
| | | Physics | -.01911- | .10655 | 1.000 | -.3247- | .2865 |
| | | Chemical | .02976 | .10017 | 1.000 | -.2576- | .3171 |
| | | Geology | .11548 | .13060 | .950 | -.2591- | .4901 |
| | Geology | Science Education | .18949 | .11248 | .543 | -.1331- | .5121 |
| | | General Science | .25300 | .12619 | .342 | -.1090- | .6150 |
| | | Physics | -.13459- | .13556 | .920 | -.5234- | .2543 |
| | | Chemical | -.08571- | .13060 | .986 | -.4603- | .2889 |
| | | Biology | -.11548- | .13060 | .950 | -.4901- | .2591 |

The mean difference is significant at the 0.05 level.