College of Social sciences and International Studies

Graduate School of Education

Teachers' beliefs about creativity and practices for fostering creativity in science classrooms in the State of Kuwait

Submitted by Hamed Alsahou, to the University of Exeter as a thesis for the degree of Doctor of Philosophy in Education, September 2015.

I certify that all material in this thesis which is not my own work has been identified and that no material has previously been submitted and approved for the award of a degree by this or any other University.

(Signature) ....

Dedication

This thesis is dedicated to those who passed away during this academic journey. I would like to dedicate this thesis to my dad, Jassim Alsahou, who died at home on April 22, 2013, while I was in England working on this thesis. Dad, I miss you so much, and I pray to Allah to reunite us again in heaven with the prophets and other good people.

I would also like to dedicate this thesis to my previous supervisor, Professor Anna Craft, who died in 2014. My deepest gratitude goes to her for her valuable reinforcement, guidance, contributions, and kindness. I was honoured to work with and learn from such a big name with a prestigious academic history.

Acknowledgement

My greatest and deepest thanks go to Allah, who gave me the inspiration, tolerance, and abilities to complete this thesis.

I am indebted to my first supervisor, Professor Rupert Wegerif, for his support, guidance and encouragement. I am grateful for all his comments and recommendations. I have learned so much from him—not only about the science of education, but also about life itself. It was an honour to work with him and learn from his prestigious expertise.

I would also like to thank my second supervisor, Dr. Nasser Mansour, for his encouragement, time, and efforts throughout the years. He was always there and believed in me. I could not have asked for a better supervisor and friend.

I am thankful to the University of Exeter, represented by its faculty and administration staff, for providing me with various opportunities to take advantage of such an effective learning environment.

I would like to extend my gratitude to everyone who participated in this study. I am profoundly thankful to the schools, teachers, and students in Kuwait who participated in this research despite their heavy workloads. Without their voluntary contributions, I could not have accomplished this study.

Warm thanks to my loving family (my mother, my wife, my children, and my brothers), who inspired me to pursue my dreams and work hard to achieve my personal and professional goals. One of my dreams has finally become a reality thanks to their support and encouragement. I am so fortunate to have them all in my life.

Thank you all

Abstract

Fostering students' creativity in school subjects has recently become a central focus of educational researchers, educators, and educational policymakers around the world. In Kuwait, educational researchers and teacher educators have supported the need to foster students' creativity via a national curriculum. Yet, the Ministry of Education has conducted few studies to explore practitioners' perspectives on how to foster creativity through the current curriculum.

The overall aims of this study were to explore science teachers' pedagogical beliefs and practices in fostering creativity in science classrooms as well as to investigate the influences of sociocultural factors on teachers' beliefs and practices in fostering creativity. The study also examined the consistency and inconsistency levels between teachers' beliefs and practices. The study has a qualitative nature that stands on an interpretive worldview. The methodology uses eight case studies, each of which consisted of a male science teacher and one of his classes. Multiple methods were used, including semi-structured interviews (pre- and post-observational interviews), student focus groups, unstructured observations, participants' drawings, and field notes. The analysis was based on thematic analysis model proposed by Braun and Clarke (2006). Thematic findings and case studies findings were drawn from the analysis of the data collected.

In general, the thematic findings indicated that science teachers are able to define the meaning of creativity and its main aspects. Professed pedagogical beliefs enforce four teaching approaches to foster creativity in the science classroom: the teaching of thinking skills, inquiry-based learning, cooperative learning, and practical investigation (experimentation). The teachers believe that these approaches could promote students' creativity in science classroom when specific sociocultural factors facilitate the effectiveness of such approaches in terms of fostering creativity. Three interdependent categories represent these facilitating factors: (1) educational setting-related factors, (2) teacher-related factors, and (3) student-related factors. Differences and similarities appeared when these professed beliefs were compared to the applied classroom practices. The thematic analysis revealed several themes underlying the main categories. Extensive teacher-centred practices and modest student-centred practices were evident; more specifically, the observations revealed primarily teacher-centred approach inside the science classes. Meanwhile, student-centred approaches were modestly applied in comparison to teacher-centred activities. The teachers justified their practices in accordance with the sociocultural factors that mediate their beliefs

and practices as well as the role of their goal orientation. The science teachers perceived the mediating factors as constraints that prevent them from applying their beliefs about fostering creativity in classroom practices. Multiple constraining factors emerged, and they were categorised into personal, external, and interpersonal constraints.

Concerning the case study findings, consistencies and inconsistencies were identified using a cut-off point as an analytic technique to classify teachers' beliefs and practices into traditional (non-creativity fostering), mixed, or progressive (creativity fostering). The case study findings identified four consistency and inconsistency levels characterizing teachers' beliefs and practices: traditional (consistent level), mainly traditional (inconsistent level), mixed (consistent level), and mainly progressive (inconsistent level). Each level was represented by an exemplary case study. The exemplary case studies revealed that sociocultural contexts influence teacher's belief-practice relationship with respect to fostering students' creativity in science classroom. Further, the thematic and case study findings were discussed in relation to the existing body of knowledge, followed by an illustration of significant conclusions, including some implications, contributions, limitations, and future suggestions.

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Abbreviations

KSA	Kingdom of Saudi Arabia
GCC	Gulf Cooperation Council
UAE	United Arab Emirates
ERCD	the administration of Educational Research and Curricula Development
Amir	the prince of the state of Kuwait
PACI	the Public Authority for Civil Information
MoE	Ministry of Education
GSSE	General Secretariat for Special Education
IQ	Intelligence Quotient
TESOL	Teaching English to Speakers of Other Languages
NACCCE	National Advisory Committee on Creative and Cultural Education
UK	United Kingdom
US	United States
EERA	European Educational Research Association
BERA	British Educational Research Association
NoS	Nature of Science
KSC	Kuwaiti Scientific Club
SACGC	Sabah Al Ahmed Centre for Giftedness and Creativity
KFAS	Kuwait Foundation for the Advancement of Sciences
KISR	Kuwait Institute for Science Research

Chapter One: Introduction

This introductory chapter aims to highlight the rationale for the current study by addressing gaps within previous literature, stating the objectives of the research, posing research questions, and clarifying the significance of the research. The chapter then ends with an outline of the thesis components.

1.1 Rationale of the Study

This section examines the rationale for conducting this study by emphasizing the importance of and the role of the teacher in fostering students' creativity, which in turn leads to the significance of teachers' beliefs about and practice in fostering creativity in their classes. It then explores the empirical gaps within the previous research. These gaps contribute to determining the objectives of the study and posing research questions. Finally, the prospective significance of the study is also highlighted here.

Fostering students' creativity has become a key aim of modern educational systems in order to prepare students to overcome future challenges. For example, Craft (2010) argued that creativity should be a major concern of educators due to three kinds of challenges—economic, social, and technological challenges—which are more likely to confront people in their future lives. Craft argued that these challenges could be overcome through creative interactivity, solutions, and thoughts. Thus, raising the creative potentiality of students is required to prepare them to solve the unexpected problems in the future (Cropley, 2001). These future challenges are more likely to be evident in the state of Kuwait, given the statistical reports of the Kuwait government, which predict future changes and challenges (see Chapter 2).

In Kuwait, researchers have similar views and believe that fostering creativity must be pervasive in public schooling in order to increase the productivity of students in the future and contribute to building their society. For example, the manager of the Research and Educational Development Sector of the Ministry of Education stated that it is necessary to develop students' creativity through integrating effective activities that enhance the creative abilities of students in public schools. It is no longer useful to offer curricular activities via the direct transmission of textbook information to enhance limited skills. Other skills and abilities must be fostered to cope with the rapid developments occurring around the world (Alsaraf, 2009).

The importance of conducting educational research on fostering creativity in education is likely to be evident. However, one question that needs to be asked is why science teachers' beliefs about and practice of creativity should be explored. The rationale for exploring science teachers' beliefs about and practice of fostering creativity can be highlighted via the following justifications.

The teacher's role is indispensable with respect to preparing students to become creative individuals who can find multiple solutions to future challenges. According to Altabti (2004), teachers facilitate the achievement of educational aims and purposes because they direct the teaching and learning processes, and they are the closest practitioners to learners. Therefore, several Kuwaiti researchers have argued that teachers are responsible for accommodating the learning environment to integrate their students' creativity. They argue that creativity cannot emerge from emptiness; rather, it needs an appropriate classroom context, which is influenced by teachers' beliefs, awareness, decisions, and practices (e.g., Abdualwahab, 2008; Abraham, 2002; Alshaikh, 2003; Sayar, Alanizi, Ward, & Almotari, 2010). As a result, teachers' beliefs about fostering creativity in schools need to be covered by educational researchers (Newton & Newton, 2009b), especially in the state of Kuwait where the ministry of education aims to reform the national educational programme for the sake of fostering students' creativity (Sayar et al., 2010).

Previous literature regarding teacher's beliefs has suggested a link between teacher's beliefs and his/her classroom practices (Berliner, 2005; Lissmann, 2005; Nespor, 1987; Pajares, 1992; Richardson, 1996; Shin & Koh, 2007; Thompson, 1992; Woolley, Benjamin, & Woolley, 2004) in that the former could affect teachers' pedagogical decisions and classroom practices. Accordingly, teachers' beliefs regarding creativity could affect their practices of fostering creativity. Additionally, the previous literature has suggested that the connection between teacher's beliefs and practices is not clear; rather, it can be based on a complex relationship because of the sociocultural influences on both of them (Ajzen, 2002; Ash, 2004; Lederman, 1992; Mansour, 2008; Robbins, 2005; Rogoff, 2003). Therefore, it is recommended to study the sociocultural influences of the teacher's context when teachers' beliefs and practices are investigated (Nespor, 1987; Pajares, 1992). Hence, there is a need to conduct a research that explores the teachers' beliefs about and practices of fostering creativity based on the role of sociocultural context. This could lead to better understanding of teachers' belief-practice relationship and address further implications that help teachers apply creativity fostering practices in the future.

On the other hand, my personal interest in this topic inspired me to carry out the current study in which both my academic background and professional experience have reinforced the area of focus of this research. After graduating from high school, I joined a Teacher College in Kuwait to be a science teacher. I was accepted into a double major programme associated with teaching science for gifted and creative students. This programme is called science education/ creativity and giftedness. During the four academic years from 2002 to 2006, I had studied scientific modules in addition to creative modules on teaching and learning of both creative and gifted students and theories of creativity. From 2006 until the end of 2009, I worked as a science teacher of intermediate level, teaching students aged 12 to 15. During this period, I realized that the relationship among teacher knowledge, beliefs, and practices in fostering students' creativity are very complex and influenced by multiple contextual factors that surround science teachers. Hence, both previous academic and professional experience helped me focus on science teachers beliefs about and practice of fostering creativity in classroom to contribute to our understanding of this complex topic.

All these motives emphasize the need to conduct a study on science teachers' beliefs about practices that foster creativity based on sociocultural framework. As a result, relevant literature was reviewed to highlight the existing gaps to be covered in the current study.

1.1.1 Exploring the gaps

There are three important gaps within the educational Kuwaiti research context. First, previous research has studied fostering the creativity of gifted students in special programmes for higher achievers within mainstream schools (e.g., Alagmi, 2004; Alagmi, 2002; Ali, 2000; Alhassawi, 1998; Aljassim, 1994), emphasising particular types of students. Accordingly, these studies did not explore the context of teaching and learning within mainstream classrooms, where all students receive their education. Recent creativity arguments have distinguished between giftedness and creativity. All people have potential to be creative, not only highly able or gifted individuals. The creative potentiality of individuals is discussed critically in later sections (see Chapter 3: Models of creativity). Therefore, the first gap is that there is a need to study creativity within mainstream classrooms instead of focusing on an unconventional group of students, such as gifted (Alagmi, 2002). The current research addresses such a gap.

Additionally, previous studies have conducted research based on explicit rather than on implicit theories. Regarding explicit theories, researchers and psychologists have examined creativity to be able to test their own assumptions. Yet, studies that investigate specialists, psychologists, ordinary individuals, or others' perspectives of creativity are based on implicit theories (e.g., Niu & Sternberg, 2002; Sternberg, 1985; Sternberg & Lubart, 1995). These two approaches are valuable and contribute to our understanding of creativity (Niu & Sternberg, 2002). However, the empirical research on fostering creativity is lacking in Kuwait; indeed, the researched context (i.e., Kuwait) has been generally investigated in relation to an explicit approach to creativity by applying experimental and scientific research designs (e.g., Alagmi, 2004; Alagmi, 2002; Alhassawi, 1998; Ali, 2000; Aljassim, 1994; Hindal, 2007). These studies adopted different scientific approaches, such as psychometric, cognitive traits, and cause and effects, to study creativity, leading to a research gap, as the complexity of the educational settings and the dynamic interactions occurring within such contexts have been ignored. As a result, this study adopted an implicit approach, which has become an attractive approach for scholars who study creativity (Lim & Plucker, 2001). More specifically, the current study is based on the sociocultural perspective of creativity that pursues subjective data (teachers' beliefs and practices) and is related to the surrounding contexts. The methodological approach of the current research is based on qualitative data collection and analysis in contrast to the studies mentioned earlier in this section.

Furthermore, these studies did not focus on teachers' beliefs and practices. Indeed, few studies have explored teachers' beliefs in fostering creativity within mainstream schools in Kuwait (e.g., Abdualwahab, 2008; Sayar et al., 2009; Sayar et al., 2010), yet they have failed to explore teachers' practices. Moreover, these studies collected the data from teachers of different subjects but did not include science teachers' beliefs. Alkharz (2013) documented creativity within TESOL classrooms in Kuwaiti schools and identified the need to explore teachers' perspectives and practices within different subjects of the national curriculum. Therefore, science teachers' beliefs and practices with respect to fostering students' creativity have not been investigated sufficiently within the Kuwaiti educational research context. Thus, the current study aims to address this gap to identify the consistencies and inconsistencies between what the teachers profess and what they do in the science classroom.

This gap has also been noted within the wider research context. Despite the fact that studies from different cultural contexts have explored science teachers' beliefs related to fostering creativity, the conclusions have emphasised the need to pursue more in-depth research on creativity in science classrooms. For example, some studies have investigated how science teachers perceive their taught subject, identifying teachers' perspective towards the nature of science education (e.g., Johnston & Ahtee, 2006; Johnston, Ahtee, & Hayes, 1998; Koulaidis & Ogborn, 1989). Furthermore, most of the relevant studies have used surveys comprising close-ended or open-ended questions to collect the data about science teachers' beliefs about creativity (e.g., Hong & Kang, 2009; Lee & Kim, 2005; Liu & Lin, 2014; Park, Lee, Oliver, & Crammond, 2006; Zhou, Shen, Wang, Neber, & Johji, 2013) while few of them used interviews as follow-up. Others have sought to explore the beliefs of pre-service science teachers (e.g., Newton & Newton, 2009b) or have examined teachers' beliefs based on their prejudged knowledge of creativity by providing incident statements to measure the teachers' beliefs (e.g., Newton, 2010; Newton & Newton, 2010). These previous studies did not compare science teachers' beliefs with their classroom practices. Recently, Meyer and Lederman (2013) studied science teachers' conception and practices to identify the fundamental components of pedagogy appropriate for creativity. However, the role of sociocultural influences and the nature of belief–practice relationships were absent in their work. Another recent study acknowledged such a deficit and suggested that future research should focus on comparing both beliefs and practices of science teachers.

> Although the study revealed what activities and strategies the teachers believed to be helpful in promoting creativity in the science classroom, it did not provide information on whether and how they were enacted in the classroom practice. Therefore, research to capture the actual practice of teaching scientific creativity should be introduced to help identify advantages and barriers of implementing specific activities and strategies to foster students' creativity and to evaluate creative outcomes. (Liu & Lin, 2014, p. 1565)

The relationship between science teachers' beliefs about and practices of fostering creativity were not evident. Additionally, these studies did not focus the role of sociocultural sources on the beliefs–practices relationship. Thus, the suggestions of Liu & Lin's study (2014) are considered in the current research by combining science teachers' practices with their beliefs.

Ultimately, identifying the research gaps helps us determine the research objectives and pose research questions to achieve these objectives. The next section addresses the aims and questions of the current study.

1.1.2 Research objectives and questions

The current research aims to explore and explain science teachers' pedagogical beliefs about and practices of fostering creativity in their classrooms in Kuwait. Specifically, five aims are included in the current research:

- The study aims to identify science teachers' pedagogical beliefs about fostering creativity in science classroom;
- The study aims to explore the sociocultural sources shaping science teachers' beliefs;
- The study aims to explore science teachers' practices of fostering creativity in their classes;
- The study aims to identify the sociocultural aspects considered by science teachers in forming their pedagogical practices; and
- The study aims to investigate science teachers' explanations regarding the degrees of consistencies and inconsistencies between their beliefs and practices.

To achieve these aims, a primary research question was generated and divided into five sub-questions: **What are teachers' beliefs and practices regarding pedagogical approaches to fostering everyday creativity in science classes in Kuwaiti intermediate schools?**

Sub-questions

Q1: What beliefs do science teachers hold about pedagogical approaches that foster creativity in the science classroom?

Q2: What are the sociocultural factors that facilitate these pedagogical approaches?

Q3: What are the pedagogical classroom practices of science teachers in Kuwaiti intermediate schools?

Q4: How do science teachers perceive the sociocultural factors that mediate their pedagogical beliefs and practices to foster creativity?

Q5: How consistent are science teacher's practices with their beliefs?

1.1.3 Significance of the research

Answering the research questions of the current study is expected to lead to significant conclusions that contribute to refining and enhancing the educational context in Kuwait in terms of fostering students' creativity in the science classroom. The prospective significance of this study can be classified into three domains, namely, teacher education, educational policies, and educational research.

The study is significant in terms of teacher education because:

- It provides a detailed account of what science teachers believe regarding creativity and how it might be fostered and encouraged in the science classroom. Teacher education can build upon the current study findings and determine how these beliefs are related to the contemporary teacher education programme. In addition, teacher educators can benefit from the findings of science teachers' practices and reconsider the content of the current pre-service and in-service courses.
- It identifies contextual factors that facilitate or limit teachers' abilities to foster creativity in the science classroom. These factors can be introduced to teacher educators to integrate strategies for coping with contextual limitations and for increasing the facilitating factors in the teachers' training programmes. Consequently, the study could help teacher educators prepare science teachers to effectively deal with contextual challenges. These lists of facilitating and constraining factors will be specific to the science classroom, which is significant, as most factors revealed in the existing literature are not specific to the science classroom (Meyer & Lederman, 2013).
- It addresses the surrounding contexts of science teachers and their relationship with teachers' beliefs and practices. Thus, it can offer an opportunity for teacher educators to recognize the effect of external forces on science teachers. As a result, teacher educators can come up with training courses to enhance science teachers' professional

networks with others who directly or indirectly influence their pedagogical decisions (e.g., policymakers, science mentors, parents, students, head teachers).

The study is significant in terms of the domain of educational policies because:

- It documents the pedagogical practices of fostering creativity inside science classrooms. Therefore, it can inform the educational policymakers about the contemporary context of the science classroom, including teachers' aims, orientations, concerns, and practices. Accordingly, it is possible that policymakers in the Ministry of Education could benefit from these findings in terms of legislating future policies and polishing old policies for the sake of fostering students' creativity.
- The study can help policymakers refine education-related constraints and challenges to fostering creativity in the science classroom. This can be done by (1) listing contextual challenges that confront science teachers and limit their pedagogical decisions and (2) listing the required needs of science teachers to apply pedagogical practices for promoting creativity in the science classroom. The Department of Science Mentorship at the Ministry of Education can use these lists of constraining and facilitating factors to develop the science classroom context as a place that welcomes students' creativity.

The study is significant in terms of the domain of educational research because:

- It provides answers that fill the research gaps within the reviewed body of knowledge. Therefore, the study can contribute to fostering creativity in science classrooms. It can also suggest further research to enrich the literature with new findings.
- The study might provide a sociocultural framework to help us understand the consistencies and inconsistencies in the belief–practice relationship in relation to the contexts that surround the science teachers.

Detailed accounts of the significance of the study are discussed in the conclusions of the current study (Chapter 10), where implications, contributions, and suggestions are highlighted based on the findings and their interpretations.

1.2 Outline of the Thesis

This thesis comprises ten chapters whose layout form an hourglass shape (see Figure 1). The study starts with a comprehensive exploration of the existing body of knowledge in the area of creativity in order to narrow down the research focus and develop research questions.

Consequently, the study determines the justified methodological decisions to answer these research questions and present findings that emerge from the methodological procedures. The findings are then discussed and interpreted in relation to others' works to draw significant conclusions that contribute to the existing body of knowledge in the focused area. The discussion stands on expanding the findings and thinking of further possibilities. Thus, it is worth providing a brief description of the thesis outline.

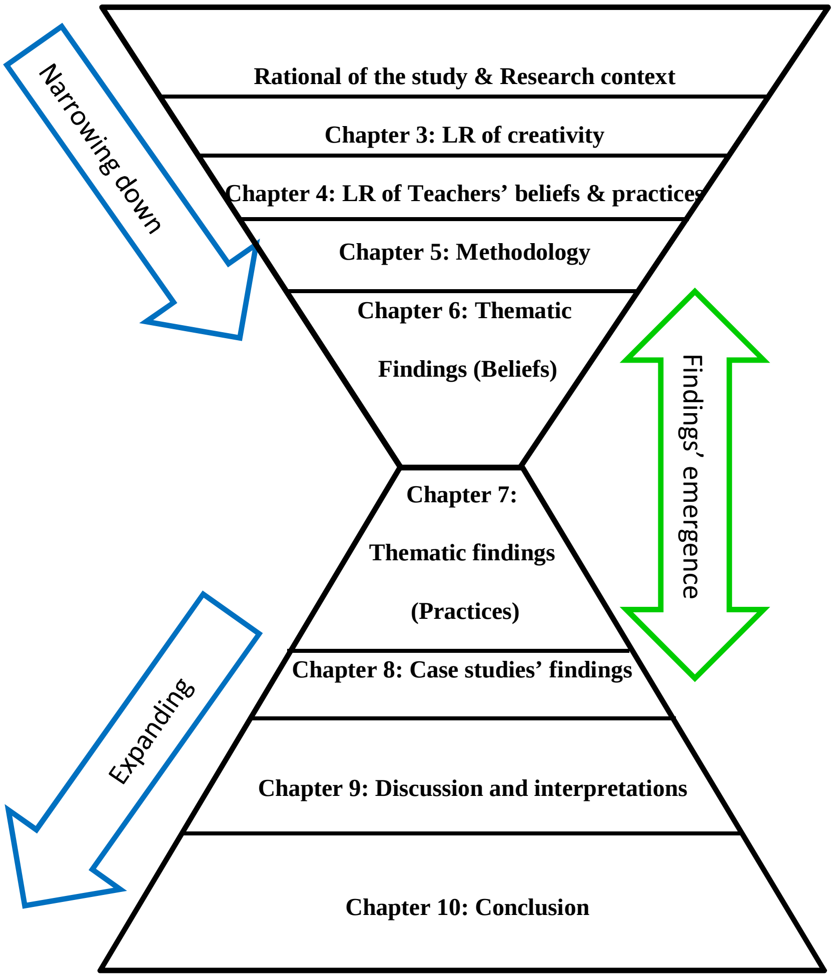

Figure 1: Outline of the thesis

The first chapter introduces the rationale of the study by exploring the existing research gaps, illustrating the objective of the research, highlighting the research significance, and defining the research questions. As an introductory chapter, it ends with an outline of the thesis chapters. The second chapter introduces the context of the study (Kuwait) in terms of the educational background, the current educational system, and the position of creativity within the educational Kuwaiti system.

The third chapter reviews the literature on creativity. There is a rich literature on creativity in which multiple definitions, approaches, models, elements, and arguments have been developed during the last 50 years. Therefore, this chapter tries to review the most relevant literature on creativity that has focused on elements, models, historical approaches or paradigms, and the sociocultural approach of creativity. Moreover, the third chapter also reviews creativity within the educational domain and addresses several educational arguments to support fostering creativity.

The fourth chapter also reviews the existing literature, but it focuses mainly on literature related to science teachers' beliefs about and practices of fostering creativity. Here, the meanings of beliefs and practices are discussed as well as the relationships among beliefs, knowledge, and practices. Beliefs and practices are also discussed with respect to the sociocultural perspective. The chapter further reviews the recent empirical works of a similar focus, including studies on science teachers' beliefs about fostering students' creativity, on effective practices of fostering creativity in the science classroom, and on supporting factors or challenging factors in terms of fostering creativity.

The fifth chapter is concerned with the research methodology. It starts by discussing and justifying the philosophical worldview followed by a discussion of the research design (eight case studies), data collection, practical procedures, data analysis, ethical considerations, and trustworthiness considerations. Each section within this chapter aims to address the methodological decisions and provide a sufficient account of why these decisions are relevant.

The sixth and seventh chapters represent the thematic findings emerging from the data analysis. For example, Chapter 6 answers the first and second research questions; thus, it presents findings regarding teachers' pedagogical beliefs about creativity and the ways in which it can be fostered in the science classroom. It also presents the facilitating factors required to foster students' creativity and create a welcoming context to support creative education. Meanwhile, Chapter 7 presents the thematic findings of the third and fourth research questions. The findings reveal science teachers' practices as well as the mediating factors between their beliefs and practices. The mediating factors are perceived as the contextual constraints that confront teachers when transferring their beliefs about fostering creativity into classroom practices.

Chapter 8 reveals the consistencies and inconsistencies between teachers' beliefs and practices. This chapter does not present thematic findings; instead, it presents the findings from the case studies. Four case studies are discussed, each of which belongs to one of the four consistency levels of the beliefs–practices relationship.

The ninth chapter expands the thematic and case study findings by interpreting them in relation to the previous empirical findings and arguments. It goes beyond the presented findings in order to draw further propositions, conclusions, recommendations, and even questions for further research. Accordingly, the tenth chapter concludes the study by deriving the research implications, contributions, limitations, and suggestions for future research. Finally, the list of appendices and references is provided.

Chapter Two: The Research background & Context

The aim of this chapter is to introduce the educational background of the research context by discussing the key themes that highlight the researched context. In the first section, three topics are reviewed to represent the background of research context: 1) A brief introduction to the state of Kuwait; 2) the history of education in Kuwait; 3) the current educational system in public schools.

Meanwhile, section 2 illustrates further contextual issues associated with the focus of the current study. The section comprises four topics: 1) fostering creativity within the Kuwaiti educational system; 2) fostering creativity and teacher education in Kuwait; 3) science curriculum at intermediate school level; and 4) science teaching and learning at intermediate school level.

2.1 The research background

2.1.1 The State of Kuwait

The state of Kuwait is a small country situated in the north part of the Arabian Peninsula. It borders with the Kingdom of Saudi Arabia (KSA), Iraq, and Iran (see Figure 2), and it is a member of the Gulf Cooperation Council (GCC), which consists of six countries (i.e., Kuwait, KSA, Bahrain, UAE, Oman, and Qatar). Kuwait occupies 17,818 square kilometres and includes nine islands. The system is based on a constitutional monarchy, where the legislative authority is conferred to the prince of Kuwait (*Amir*) and the National Assembly Parliament. According to clause (6) of Kuwait's constitution (1962), "The System of Government in Kuwait shall be democratic, under which sovereignty resides in the people, the source of all powers. Sovereignty shall be exercised in the manner specified in this Constitution."


CYPRUS
SYRIA
LEBANON
Beirut
Damascus
Mediterranean Sea
Tel Aviv Yafo
Amman
JORDAN
IRAQ
Baghdad
Tehran
IRAN
AFGHANISTAN
Basra
KUWAIT
Cairo
EGYPT
QATAR
SAUDI ARABIA
Riyadh
UNITED ARAB EMIRATES
Muscat
Karachi
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Khartoum
SUDAN
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Sana'a
YEMEN
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Arabian Sea
Djibouti

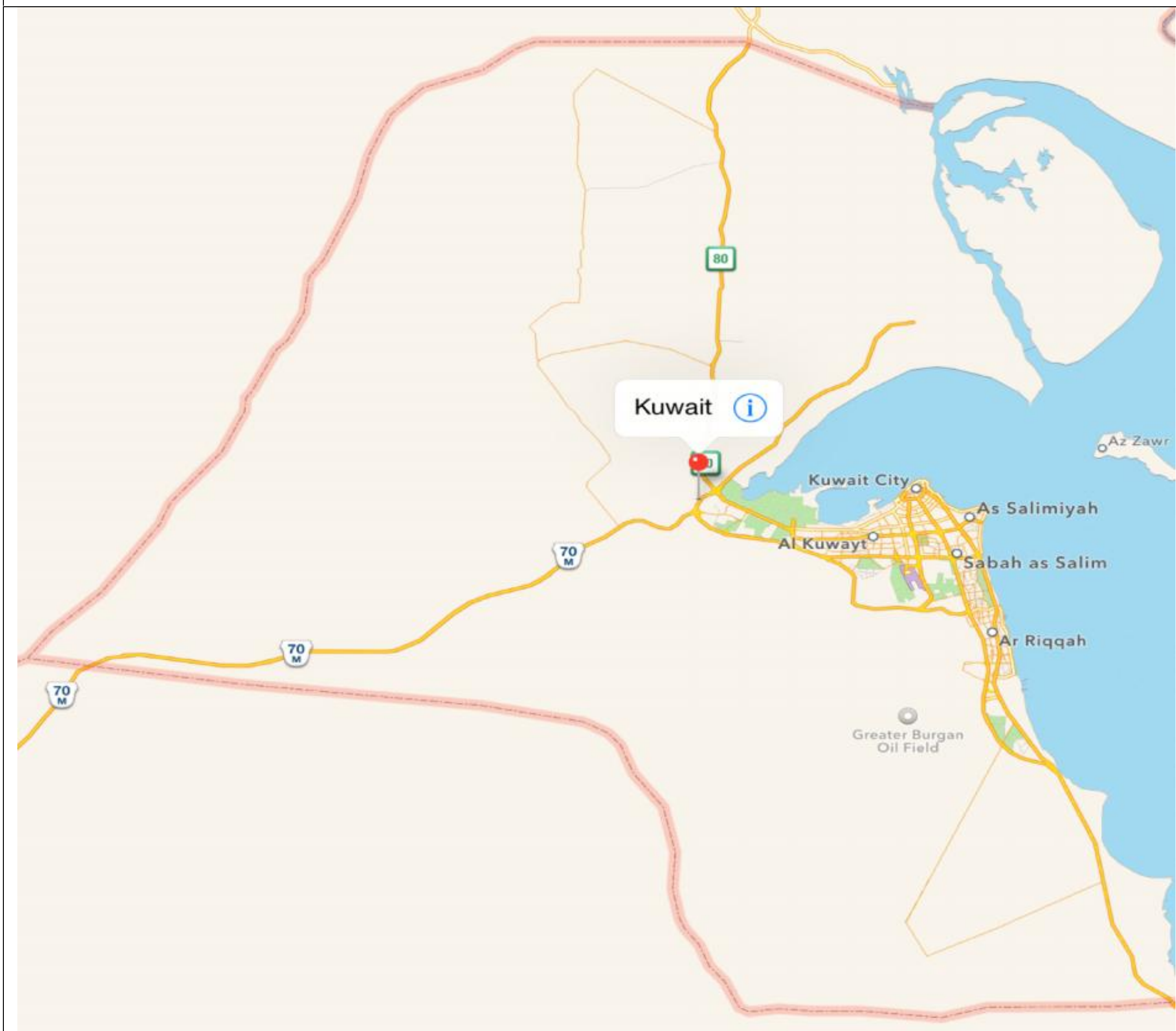

80
Kuwait
Az Zawr
Kuwait City
As Salimiyah
Al Kuwayt
Sabah as Salim
70 M
Ar Riqqah
Greater Burgan Oil Field

Figure 2: The map of the state of Kuwait (adopted from Google Maps, 2015)

With respect to the population, people inhabit the coastline areas that are distributed into six governorates. The Public Authority for Civil Information (PACI, 2014) reported the population of just over 4 million, of which 1,278,963 are Kuwaitis whereas the rest are expatriates. According to the report, one of the long-term aims of the Kuwaiti government is to create a balance between the number of Kuwaitis and expatriates because of the high rate of population growth among Kuwaiti residents.

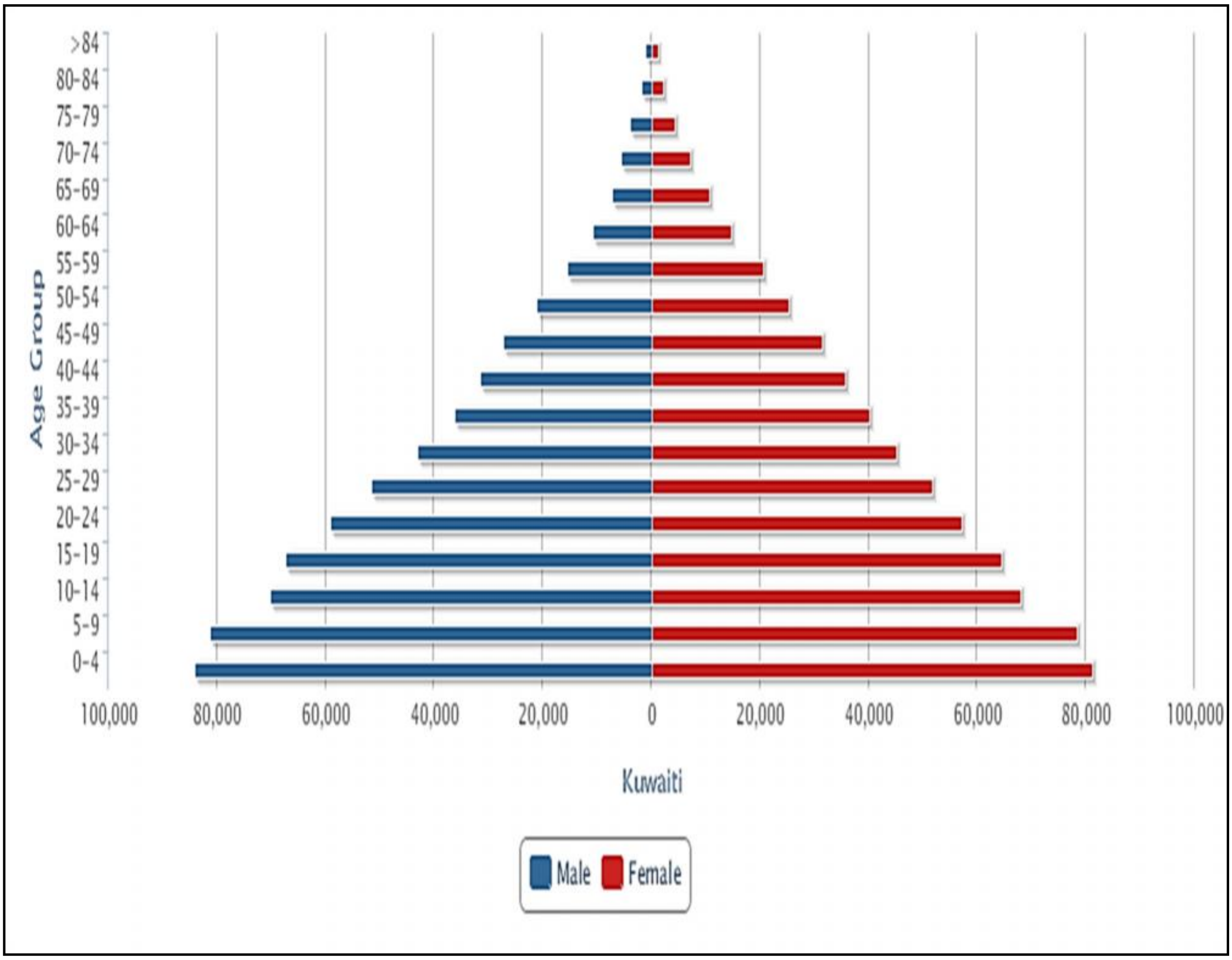


Figure 3: Population of Kuwaitis according to age groups (PACI, 2014)

Indeed, the Kuwaiti society is considered a young society based on the birth rate compared to the death rate. For example, the Oxford Business Group (2013) reported that 60% of

Kuwait's population is under the age of 24, and the population growth is around 2.8%. The pyramid in Figure 2 shows that Kuwait's population is rapidly growing. Such growth imposes future challenges related to the social life, economy, demography, and public services. Therefore, it can be argued that creative education needs to be fostered in public schools in order to prepare future generations to cope with the prospective changes. Here, I shall narrow down the focus of the Kuwaiti context to discuss its educational system.

2.1.2 History of formal education in Kuwait

The educational developments in Kuwait have gone through different stages to reach the current level of development. Local historians have examined the development of education in Kuwait, gathering information about education in Kuwait since the early 18th century.

Mosques were the starting point of education in the Kuwaiti context. People attended mosques to worship God as well as learn about religious beliefs, regulations, and practices. People also tended to send their children to the mosque to be taught by the "sheikh" (the religious man who is responsible for the mosque and possesses religious knowledge) how to read, write, recite the Holy Koran, and master algebra (Alfarhan, 1960; Haateem, 1980). Education in the mosques contributed to an increasing number of people developing literacy and numeracy knowledge. As a result, society became increasingly aware of the importance of teaching its children literacy and numeracy lessons in order to be hired by Kuwaiti merchants who needed employees to do paperwork, such as calculating and recording commercial procedures. Parents' increased demands to educate their children led to the new developments of education, which emerged in the late 18th century, and some people started to offer educational lessons in their houses, focusing primarily on literacy, numeracy, the reciting of the Holy Koran, and other topics, depending on the teacher's abilities and knowledge (Alabdulqhafoor, 1983; Almohaini, 1974). This situation continued for several decades, until 1911.

In 1911, a group of Kuwaiti merchants decided to establish a formal school and financially support it on a regular basis. One year later, the first school was inaugurated and called Al-Mubarakia. It welcomed approximately 300 male students. After few years, another male school was established and called Al-Ahmadia. The Kuwaiti people funded these schools; therefore, the financial support of the schools was restricted by the economic status of people

(Al-Abdulqhafoor, 1983). For economic reasons, people were not able to fund the schools in the early 1930s; therefore, the Kuwaiti government established the Council of Cultural Affairs in 1936 to manage schools and fund formal learning programmes.

Once the Kuwaiti government controlled the educational sector, dramatic developments in the education system happened in 1936. According to Alrashed (1995), the government played a significant role in developing the educational services during this time by making fundamental decisions, such as (1) establishing the Council of Cultural Affairs; (3) building more schools for male and female students; (3) imposing a 5% tax upon imported goods to pay for formal education; (4) developing a formal curriculum and including more subjects, such as history, geography, health principles, science, math, engineering, art, and English language; (5) inviting the educational Palestinian mission to contribute to developing the education and cooperate with Kuwaiti teachers to teach students; and (6) funding educational scholarships for Kuwaitis to study abroad. In 1942, the Kuwaiti government asked the Ministry of Education in Egypt to participate in developing the educational system in Kuwait and share their educational experiences with the Kuwaiti educators; therefore, Egypt sent an educational mission to Kuwait to raise the quality of education at that time (Abdalmatti, 1995). In the 1950s, more developments were evident, including the establishment of schools to specifically accommodate students with special educational needs.

Further development emerged in 1962, when Kuwait's constitution was established. Clause (40) of the constitution states that education is free in all levels (i.e., primary, intermediate, and secondary) and compulsory in the first level.

A) Education is a right for Kuwaitis, guaranteed by the State in accordance with law and within the limits of public policy and morals. Education in its preliminary stages is compulsory and free in accordance with the law.
B) The law lays down the necessary plan to eliminate illiteracy.
C) The State devotes particular care to the physical, moral, and mental development of the youth (Clause 40).

Kuwait's Parliament agreed that all Kuwaiti students of both genders should register as full-time students at the primary and intermediate school levels, and that the Ministry of Education would manage schools. Meanwhile, high schools were not considered a part of primary education, so it was not compulsory. The developments within both basic and higher educational systems, such as the establishment of the University of Kuwait, increased the number of schools, especially during the 1960s. Later, parliament made some modifications to make primary and intermediate school levels compulsory for all children, not just Kuwaiti students, in order to include the non-Kuwaiti residents. Moreover, kindergartens were funded by the Ministry of Education to prepare four- to six-year-old children for primary school (Alrashed, 1995).

Because of the historical developments in education, the number of illiterates in Kuwait is very small. According to a local newspaper (*Al-Watan Newspaper*), the Minister of Education announced in an official conference that the percentage of illiterates among Kuwaiti males is only 1.07% and among Kuwaiti females is 5.02% (Alessa, 2015); the great majority of these illiterates are elders over 64 years old, according to the statistical report by PACI (see Figure 4).

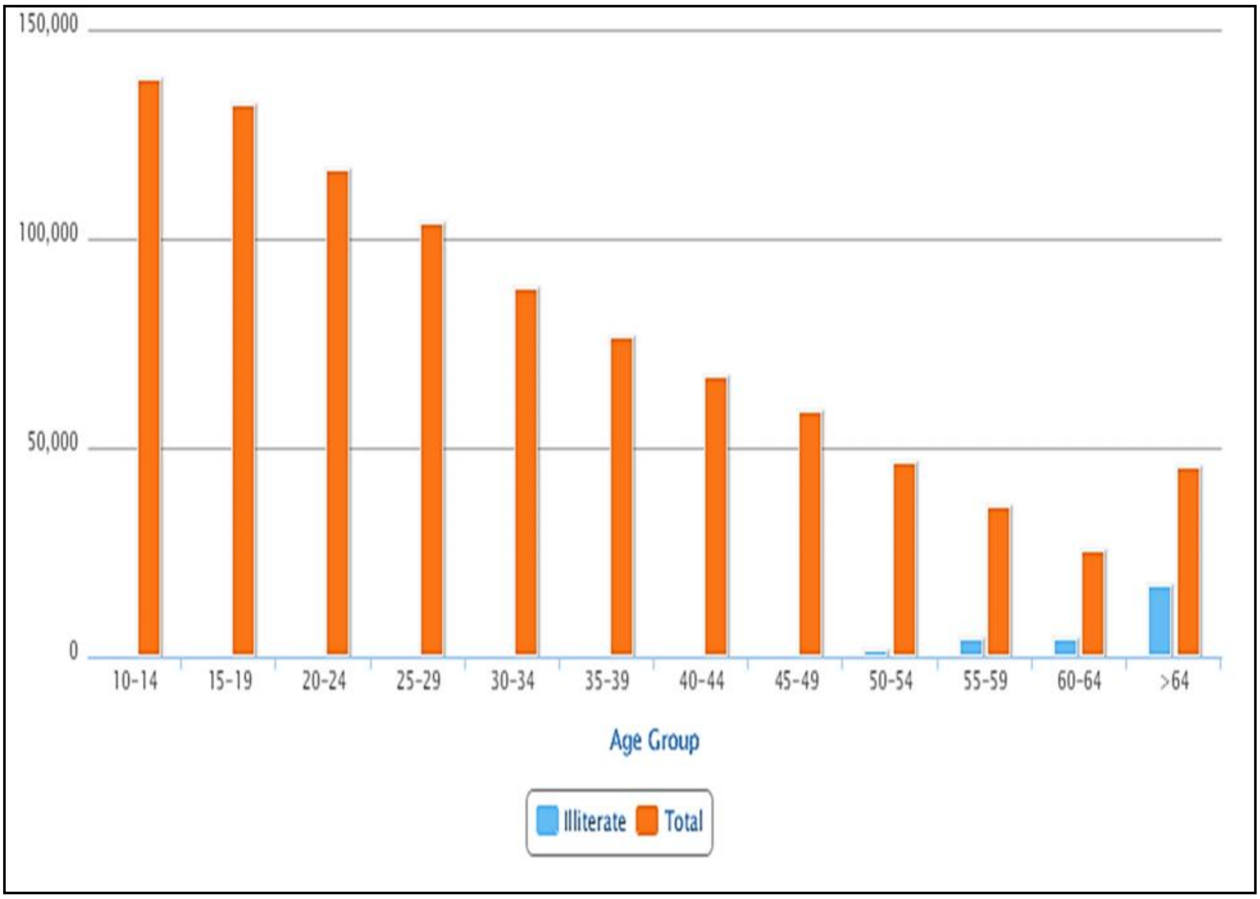


Figure 4: The June 2014 statistical report of Kuwaiti illiterates (PACI, 2014)

According to the Ministry of Education (MOE), it is important to provide educational opportunities for all Kuwaiti population to eliminate illiteracy and develop the quality of education (Alessa, 2015).

2.1.3 Education in public schools (government schools)

The brief historical exploration of Kuwait's educational development illustrates different stages that shaped the current education system. Here, I would like to review the general information of the current educational status in Kuwait. The Ministry of Education has the authority to shape the educational curriculum, educational schema, general educational aims, and assessment criteria. Thus, the educational system appears to be based on a centralised approach.

The Kuwaiti schooling system comprises four levels. The kindergarten level nurtures four- to six-year-old children. The primary level consists of five grades (1–5) for children aged 6 to 11 years. The intermediate level contains four grades (6–9) for students aged 12 to 15 years. The secondary level comprises three grades (grades 10–12) for students aged 15 to 17 years. Secondary school students should specialise in one of two areas of study (scientific field or humanities field).

With respect to the statistics of public education provision, Table 1 presents recent statistics by the Ministry of Education published in local newspapers (e.g., *Al-Watan Newspaper*). The articles highlighted that the number of students is increasing, resulting in the need to increase the number of schools and staff. The Ministry of Education must also enhance the quality of education in public schools.

Government schools also follow the law of gender separation in educational provisions. Male and female students receive similar academic education, but they are taught in separate schools, with the exception of kindergartens that offer education to both genders in the same school. Female teachers teach kindergartens. Female teachers also teach most primary schools, except for 14 male primary schools still managed by male teachers. Intermediate and high school students are taught by teachers of their own gender.

Table1. Numbers of students and teachers in Kuwaiti governmental schools (MOE, 2013)

Statistics from 2013–2014	Kindergarten level		Elementary level (primary)		Middle level (intermediate)		High level (secondary)		Total	
	female	male	female	Male	female	male	female	male	female	male
Students	**43268**		**143986**		**107601**		**68078**		**362993**	
	22182	21086	74944	69042	55807	51794	38718	29360	191651	171342
Teachers	**6259**		**24780**		**18710**		**13514**		**63263**	
	(females only)		23697	1383	10309	8401	7698	5816	47663	15600
Schools	**199**		**259**		**206**		**139**		**803**	
	(mixed)		126	133	106	100	74	65		

Note. Students, teachers, and schools in the private sector are excluded; the numbers refer to the governmental sector only.

2.2 The Research Context

Here, I would present some contextual information about fostering creativity as well as science education to highlight the researched context. Four issues are presented in this section, namely 1) fostering creativity within the Kuwaiti educational system; 2) fostering creativity and teacher education in Kuwait; 3) science curriculum at intermediate school level; and 4) science teaching and learning at intermediate school level.

2.2.1 Fostering creativity within the Kuwaiti educational system

Since 1988, Kuwaiti educators have paid attention to creativity by focusing on students who show creative abilities on standardised tests. They have developed special programmes (e.g., gifted and talented programmes) to allow these students to engage in appropriate environments that nurture their creativity, develop their talents, and meet their high mental abilities. Such programmes follow specific criteria to identify students as gifted and accept them in these special provisions, including standardised tests for intelligence as well as performance and achievement records.

The General Secretariat for Special Education (GSSE) under the Ministry of Education is concerned with gifted and creative students. According to the GSSE (1998), gifted programmes are one of the most valuable provisions for developing students' creativity in many fields of knowledge. Such programmes are built on introducing problems to students without providing direct solutions to create opportunities to think about the issues from multifaceted angles rather than from one directed manner. In addition, it aims to create a connection among the accumulated knowledge, acquired skills, and the new learning experience in all curricular fields by applying pedagogical approaches that foster creativity (GSSE, 1998).

Nevertheless, programmes have been limited to certain students who fit the GSSE's criteria and definition. According to Almashaan (2001, p. 64), the definition of a student who can enrol in such programmes is one "who has a mental ability to help him/her in the future to reach a high performance. Emphasis is given on academic ability, leadership skills, and skills in the performing arts". In addition, the student must have specific characteristics to be eligible for the programme, including (1) high grades in academic courses, placing him/her in the top 5% of the student's age group; (2) above-average IQ test scores (i.e., not less than 120); (3) a high level of creative thinking measured by standardised tests; and (4) a high capacity for collective leadership and effective reactive behaviour.

Several studies have investigated creativity in enrichment programmes for gifted students in Kuwait. Their findings have indicated that students who enrol in such programmes experience positive effects, such as emotional and personal development as well as creative development (Alomar, 2000). Alhassawi (1998) also found that the gifted curriculum enhances students' skills, challenges their mental abilities, and fits their creative and thinking abilities. It is worth mentioning here that the Ministry of Education adjusted the gifted programme to allow for further development and preparation in 2009.

Researchers and educators have argued for the need to integrate creativity in public schools during the last 15 years. As a result, modest changes have been made within the teacher education programmes to teach prospective teachers general theories about creativity and creative education. This point is discussed in the following section.

2.2.2 Fostering creativity and teacher education in Kuwait

Kuwaiti researchers have argued that creativity should be fostered within the national curriculum, allowing students to develop abilities and demonstrate effective personal development. The reason for that is that creative potentiality is not restricted to gifted individuals. For example, Alagmi (2002) claimed that searching for a gifted minority is no longer useful. Rather, it is vital to ensure that all learners invest in their knowledge, skills, attitudes, and values—all of which are the essential elements of personal development and effectiveness. These individual areas of development contribute to building humanity's power to cope with the civil challenges facing modern societies (Abdoalmohasen, 2002).

As a result, educational perspectives have commonly focused on achieving emotional and cognitive changes that fit students' needs and personal development from different angles. Thus, the educational system needs to focus on enhancing students' critical and creative thinking skills as well as their attitudes towards learning (Abdoalmohasen, 2002). Educational institutes, especially schools, should focus on creating the best conditions to help students develop free thinking and abilities to solve their problems in distinctive and creative ways (Alagmi, 2004).

Therefore, researchers criticised the fostering of creativity solely among gifted students, as they believed that students in mainstream schools should have the opportunity to build their creative potential as well. Education should focus on honing the skills of all students rather than only skill of a select minority (Alagmi, 2004). All students can demonstrate a level of creativity that differs in terms of its strengths and effects; thus, equal opportunities for all students are needed (Alhassawi, 1998). Alagmi (2004) devised public schools to welcome students' creativity by integrating open-ended activities, such as open-ended inquiries, questioning approach, practical discovery, instructional games, role playing, and brainstorming. He further called for adopting new policies that ensure stimulating factors in mainstream classrooms to encourage students to become more curious, become risk takers, and engage in creative activities.

Teacher educators seem to have considered researchers and educators' concerns. For example, Abdualwahab (2008) reviewed the modules taught in teacher education programmes and found that pre-service teachers are taught at least two modules related to creative education; however, these modules are optional. In 2002, the Basic Education College in Kuwait established a teacher programme to produce teachers with double domains in which pre-service teachers specialised in a particular subject (e.g., science, mathematics, English language, Arabic language, history, and religious education) and in creative and gifted education. The aim of this approach is to provide teachers who can foster creativity in regular schools. Personally, I graduated from this teacher education programme in 2006 with science major and creativity and giftedness as my minor. With respect to the in-service courses, the Ministry of Education arranged different training courses, seminars, and workshops, some of which highlighted general issues about creativity (Abdualwahab, 2008).

2.2.3 Science curriculum at intermediate school level

In 2008, the ministry of education in Kuwait aimed to reform the science curriculum at all schooling levels: primary (grades 1-5), intermediate (6-9), and secondary (10-12). The ministry made a contract with Pearson-Scott Foreman Company in the USA to adopt their original curriculum and refine it to fit the Kuwaiti cultural context. The purpose of science curriculum is to nurture a generation that can cope with future changes and solve local and universal problems through scientific manners. Thus, science education is one of the major educational facets facilitating the education of students in the Kuwaiti educational system in which students study science from age 6 till age 17. At the intermediate schooling level, students attend at least 4 science sessions per week taught by teachers who are dedicated to teach only science.

The new science curriculum at intermediate level has been applied in 2010, which is based on the spiral approach covering areas related to geoscience, physics, biology, and physiology. The curriculum is vertically and horizontally spiral. It is vertical in the sense that the subject matter is iterated during the school career. For example, student from the ninth grade can return to an old knowledge or skill gained in the eighth grade. In other words, the curriculum connects topics taught in different school grades with an increment in the complexity of the topics over grades. It is also horizontal in the sense that the subject matter can be connected with other curriculum subjects, such as math, art, geography, and other (MoE, 2012a). Furthermore, the science curriculum aims to focus on developing specific skills and abilities of students aged 12 to 15. For example, the curriculum developers addressed nine major abilities that teachers should focus on when teaching science at intermediate level, which are:

- The ability to discover and analyse patterns, including the ability to describe, explain, and expect.
- The ability to verbally and editorially communicate through scientific language.
- The ability to use the mathematical and scientific symbols.
- The ability to conduct scientific research, including the ability to observe, explore, experiment, and examine.
- The ability to design and adopt scientific models.
- The ability to think critically.
- The ability to think creatively.
- The ability to solve problems based on sequential steps.
- The ability of apply their integrative and associative thinking in their learning (MoE, 2012a).

Consequently, the current curriculum focuses on enhancing mental abilities of teenagers and their capacities to learn science as scientists based on the scientific approaches to understand scientific subject.

2.2.4 Science Teaching and Learning at intermediate school level

According to the science mentorship department, active learning mode is encouraged as the major approach of formal science learning. It means that the students engage in constructing their learning process as interactive participants. This can be achieved through considering science as a body of knowledge and approach to knowledge. Hence, the learning is not restricted by the information and topics addressed in the science textbook; instead, scientists learn the scientific approaches to reach the scientific knowledge, which is the focus in science classroom. Therefore, the classroom practices should avoid recitation and direct learning activities as much as possible. In contrary, the classroom practice shall encourage students to think scientifically and build their inductive and deductive thinking skills to learn science.

In terms of teaching science, the science mentorship has differentiated recommended major approaches to teaching science at intermediate level, which can be summarized as follows.

- **Teacher-centred approach** represents teaching strategies that focus mainly on the teacher practice to deliver lessons, such as lecturing and demonstrating scientific shows. The students are more likely to be passive recipients and inactive learners. This approach is also known as direct teaching because it can be used for direct transmission of knowledge.
- **Student-centred approach** represents teaching strategies that ensure active learning, allowing students to play a key role in their learning process. The students assume the responsibility for learning the course content. Multiple approaches support student-centred learning, such as discussion, cooperative learning, induction and deduction, problem solving, guided inquiry, and semi-guided inquiry.
- **Self-learning approach** is the learning process based on the student efforts, so that it is perceived as indirect teaching method. Self-learning approach can be represented by instructional packages, using virtual learning facilities, conducting unguided inquiry (open inquiry), and conducting experimentations and observations (MoE, 2012b).

According to the department of science mentorship, science teachers are free to apply any pedagogical approach that can achieve the targeted objectives of the taught lesson. However, the teacher should be aware of significant issues before making pedagogical decisions, such as the chronological and mental age of the students, the teacher's ability and skills to adopt particular approach, the content of the subject matter, the availability of equipment and resources, and the class size. Science teacher needs to consider these issues to adopt relevant teaching approach. Therefore, science teacher should review the teacher's book before preparing classroom activities because it contains various pedagogical ideas and suggestions.

2.3 Summary of the chapter

This short chapter highlighted the research background and context. The background of the state of Kuwait and the history of education in the researched context were briefly reviewed.

Then, the current data regarding the governmental schooling provision was illustrated, including the number of students, teachers, and schools.

The second section addressed issues related to the research context, including 1) fostering creativity within the Kuwaiti educational system; 2) creativity and teacher education in Kuwait; 3) the current science curriculum; and 4) science teaching and learning.

Chapter Three: A review of the creativity literature

3.1 Introduction

The last chapter detailed Kuwait's educational background as a study context and addressed the historical development of education and the status of fostering creativity within Kuwait's educational system. This gives some context to the research rationale outlined in chapter 1, which explains the research gaps, aims, questions, significance. It is significant here to remind the reader that these previous elements have guided me to review literature that is relevant and related to the research focus and which is divided into two chapters (i.e., creativity and science teachers' beliefs of and practices for creativity).

Hence, this chapter explores the key issues in the field of creativity. It begins with the meaning of creativity by discussing its multiple definitions and models. Second, it explains the reason for the existence of multiple definitions when comparing diverse theoretical bases or approaches to explain creativity. The chapter next explores creativity from a sociocultural approach and demonstrates its differences with respect to the other theoretical approaches. Then, the literature of creativity in education is discussed, including (1) an exploration of the importance of creativity in education; (2) a comparison of creative teaching, teaching for creativity, and creative learning concepts; and (3) an exploration of the relationship between certain pedagogical aspects and creativity. Finally, a reflection is developed to summarise the chapter and provide the tools for this study as well as introduce the next chapter.

3.2 Models and Elements of Creativity

Creativity definitions have progressed over time. It has long been understood that creativity is a versatile subject (Torrance, 1966). Many people believe that creativity is a fundamental constituent in accomplishing a distinction in an extensive diversity of fields (Cook, 1998); however, it is an enigma and an ambiguity (Boden, 1996). According to existent literature, creativity can refer to the emergence of something that did not exist before. Feldman (1994) described creativity as "the achievement of something remarkable and new, something which transforms and changes a field of endeavour in a significant way" (p. 1). This definition indicates that this concept has an outcome (i.e., "something") that is novel and useful in developing a certain field. Amabile (1983) described creativity as an appropriate and novel outcome by one person or a group of people. Sternberg and Lubart (1999) stated that "creativity is the ability to produce work that is both novel (i.e., original, unexpected) and appropriate (i.e., useful, adaptive concerning task)" (p. 3).

These definitions reveal that the new and useful "something" sometimes appears to be a product, person, or process. Indeed, creativity has been examined using three chief models: process (e.g., Boden, 1994; Koestler, 1964), person (e.g., Gough, 1979; Guilford, 1950), and product (e.g., Amabile, 1983). However, the literature has also indicated that a fourth model exists that refers to creativity as an environment (e.g., Amabile, 1989; Baer & Kaufman, 2005; Csikszentmihalyi, 1996; Torrance, 1977). According to Taylor (1995), any human activity can be studied from four angles: the individual who does it, the object that is done, the action process, and the circumstances that impact the three previous positions. Taylor argued that the four forms interact and are interconnected to one another. For example, the creative product can be considered a construction of the creative process whereas the creative abilities and personal traits affect the creative process. In the same way, the environmental circumstances affect the creative person, process, and product. Correspondingly, an early framework established by Rhodes (1961) studied creativity portrayed by the '4Ps' of creativity, which refer to creativity as a person, process, product, and press. Rhodes exemplified creativity as a person by covering information on personal aspects, traits, intellect, and temperament; meanwhile, creativity as a product refers to ideas and thoughts altered into a tangible character. Creativity as a process is represented by the mechanisms of learning, thinking, and communicating as well as an individual's perceptions and motivation. Finally, creativity as press studies the interaction between the individual and the surrounding environment.

Other theorists and researchers have viewed creativity from different angles, leading to two general models: big C creativity (known as historical creativity) and little C creativity (known as psychological creativity). Recently, some creativity theorists indicated that new models of creativity have emerged as well, such as professional C and mini C. I seek to review these elements and models to develop a clear vision of how the literature defines creativity.

3.2.1 Elements of creativity

3.2.1.1 Person element of creativity

Many studies on creativity have identified characteristics correlated with creative behaviours (e.g., Barron & Harrington, 1981; Oldham & Cummings, 1996). Eysenck (1997) suggested an outline of the characteristics of creative people. Feist (1998) stated that empirical research over the last 45 years has made a rather convincing case that creative people behave consistently over time and in different situations as well as in ways that distinguish them from others. Feist asserted that, in general, a creative personality “does exist and personality dispositions do regularly and predictably relate to creative achievement” (p. 304). Other writers have highlighted the characteristics of individuals’ creativity by defining and determining personal traits and characteristics related to creative accomplishment (Davis, 1989). Reviewing such literature shows that numerous characteristics are considered to be features of the creative person, such as intelligence, imagination, originality, curiosity, an artistic nature, an energetic nature, risk-taking, and open-mindedness (Barron & Harrington, 1981; Taylor, 1995; Torrance, 2004). Moreover, these investigations have highlighted a fundamental set of characteristics associated with creative actions in different areas of human endeavours, such as insight, aesthetic sensitivity, tolerance of uncertainty, self-assurance, expanded inquisitiveness, and the ability to deal with complexity (Barron & Harrington, 1981; Gough, 1979).

Guilford (1950, p. 444), for example, defined the creative person according to the nature of traits and abilities: “Creative personality is then a matter of those patterns of traits that are characteristic of creative persons.” In 1959, Guilford came up with six aptitude traits related to creativity: originality (i.e., the capability to produce uncommon and satisfactory thoughts); sensitivity to problems (i.e., the capability to discover problems); redefinition (i.e., the capability to perceive the problem from various angles); fluency (i.e., the capability to generate numerous ideas in a period of time); flexibility (i.e., the aptitude to modify mind set with no difficulty); and elaboration (i.e., the capability to develop upon the focused area and its solutions). Guildford further suggested that these abilities diverge, and such dissimilarities might account for the diversity of creative persons. According to Dacey (1989), previous studies have accumulated lists of traits and characteristics that claimed to be features of creative people. For example, Tardif and Sternberg (1988) amalgamated characteristics into collections. Starko (2001) subsequently adopted these results to produce two types of lists: cognitive and personality. The cognitive list contains metaphoric thinking, flexibility and skills in decision making, independence in judgement, ability to cope well with originality, logical thinking skills, visualisation, ability to escape entrenchment, and ability to find order in chaos. Meanwhile, the personality list comprises willingness to take risk, commitment to task, curiosity, openness to experience, tolerance to ambiguity, wide interests, valuing of originality, intuition, and sensitivity.

However, Boden (1990) argued that the traits that creative persons use are similar to those that all people use. Boden argued that creative people are not a particular brand of humankind; rather, their creativity draws upon ordinary abilities, such as "noticing, remembering, seeing, speaking, hearing, understanding language and recognising analogies" (p. 245). According to Boden, what makes creative people different from others is their widespread knowledge of a particular field. This explanation is in line with Csikszentmihalyi's (1996) study that focused on 100 socially well-known creative persons. The findings revealed that the first and most significant characteristic of the person is the mastery of a field of knowledge. Moreover, Faultley and Savage (2007) stated that the trait theory of creativity indicated that specific individuals have the ability to be creative; however, modern commentators do not view it in that way, stating that creativity is a facility possessed by all people.

3.2.1.2 Product element of creativity

Some authors have suggested that creativity is a product or substance phenomenon because it is based on generating something new (Lynch & Harries, 2001). Brogden and Sprecher (1964, p. 6) clarified the kinds of products that exist: "A product may be a physical object—an article or patent—or may be a theoretical system. It may be an equation or new technique. It is not uniquely bound up with the life of an individual". Therefore, creative product research focuses on the outcomes regardless of the producer and the process of production; this might be a result of considering the product to be a very expedient criterion of assessing creativity.

As discussed by Mathers (1996), the product is measured and evaluated according to an originality (newness) criterion, which is the first and most important criterion. Other authors added the usefulness criterion, focusing on the feasibility of the product for the individual or the society. Barron (1988) pointed out that the product should be innovative and purposeful; Rothenberg (1983) further stated that creations are unique and precious products. Creativity should been seen as a social value; thus, there are two conditions for understanding creativeness: a novel concept or idea and its advantage to someone or some people. These two criteria should be met when assessing any product in order to call it a creative outcome (Russ, 1998).

A creative outcome such as ideas, acts, or objects should make an original change in the current context and transfer it to a new one. This belief raises a question regarding the boundaries of originality or newness. Originality here can be evaluated through subjective judgement, which differs from person to person. According to Guilford (1987), originality means "statistically infrequent". This description suggests that the originality of something depends on its history—namely, we can consider something to be original if no such thing has been produced throughout history. Jackson and Mersick (1965) connected the term originality or novelty to unusualness and evaluated it using two steps: judging the product against other identical or similar products of similar purpose and calculating the results from the comparison step. Boden (1994) explained the term originality in a clearer way by dividing the concept of creativity into psychological creativity (P-creativity) and historical creativity (H-creativity). "An idea is P-creative if the person in whose mind it arises could not have had it before; it does not matter how many times other people have already had the same idea. By contrast, an idea is H-creative if it is P-creative and no one else has ever had it before" (1994, p. 5). Boden's definition demonstrated that P-creativity does not need to be based on a "statistically infrequent" act or idea to be considered creative. Actually, the two types of novelty or originality are psychological originality (P-originality) and historical originality (H-originality).

Researchers also agree on the importance of the product and how it contributes to the individual's or society's development. This might indicate the significance of the appropriateness character because it can distinguish between a creative product and an odd or unusual one. Yet difficulties arise when the appropriateness judgement is pursued due to its subjective natural. The assessment of the usefulness of a product differs from one person to another and from one society to another; thus, what one might consider to be a creative product in one cultural context might not be considered creative in another cultural context (Brannigan, 1981). Guilford (1957) further exemplified the assessment of usefulness in two ways: logical consistency (facts) and less-than-logical consistency (experience). For example, the usefulness of a new way of solving a mathematical problem might depend on facts and logics; meanwhile, the usefulness of a piece of poetry could be based on experience more than facts. Corresponding to the two characters, the creative products have aesthetical signs that observers of the product comment on. According to Jackson and Mersick (1965), these signs are stimulation, satisfaction, surprise, and savouring. These aesthetical reactions emerge due to the appropriateness and originality of the creative product. Reactions such as surprise and stimulation are related to the character of originality whereas reactions such as satisfaction and savouring are related to the usefulness or appropriateness character (Amabile, 1983).

3.2.1.3 Process element of creativity

Boden (1994) believed that the creative process occurs when the conceptual spaces are explored and transformed. The conceptual space is a system of knowledge that includes structured sets of knowledge collections bonded to one another by links (Santanen, Briggs, & deVreede, 2002). According to Boden (1994), the exploration of a conceptual space means reviewing these sets of knowledge collections. Meanwhile, the transformation of a conceptual space refers to the emergence and addition of a new knowledge collection into a set of knowledge collection. Koestler (1964) put forth a similar view, describing the creative process as a bi-sociative process because it occurs when a person joins alienated matrices of thoughts. These matrices have similar meanings as the collections of knowledge. Thus, Ward et al. (1997) concluded that the creative process is based on connecting the existing bodies of knowledge and generating new bonds between them. Sternberg (1997) concluded that a creative process is an intelligence action described as being statistically atypical and highly beneficial. According to Torrance (1977), the creative process involves feeling a problem, generating thoughts and assumptions, assessing the thoughts or assumptions, and resolving the outcomes. Davis (1989) agreed with Torrance by asserting that creativity is based on sequential procedures operated by a creative person to identify the problem, work on it, and solve it.

An early model by Wallas (1926) defined the creative process in four stages: (1) the preparation stage, which is concerned with gathering data, collecting information regarding the problem area, and coming up with the most appropriate thoughts; (2) the incubation stage, in which the person does not consciously work on the problem, yet uses the cognitive abilities to work on the problem unconsciously; (3) the illumination stage, when the person consciously works on the new ideas to reach an unexpected insight, in which the new thoughts are formulated and fitted together; and (4) the verification stage, when the solution is practically confirmed and can be modified as necessary. According to Csikszentmihalyi

(1996), Wallas's model is still applicable, especially given that Wallas subsequently added a fifth stage: elaboration. The elaboration stage suggested that the creative outcome needed to be prepared for the final presentation, which Csikszentmihalyi (1996) considered to be the hardest, most time-consuming stage. These stages can occur in a different order, and some can be combined into one stage (Dacey, 1989; Davis, 1997; Davis & Rimm, 1998). Basadur (1982) discussed another example of the creative process: generating a creative problem-solving model. This process comprises three phases: identifying the problem, solving the problem, and implementing the solution. Each phase includes two steps: ideation (generating the ideas without being critical) and evaluation (judging the ideas, excluding the poor ideas while keeping the best ones). This model can differentiate between the behaviours of problem solving (finding the problem, solving it, and implementing the solution) and the cognitive process (ideation and evaluation). Similarly, a great number of forms and different explanations of the creative process have been used in many different fields as strategies to demonstrate creativity.

3.2.1.4 Environment element of creativity

Creativity needs an embracing context that allows for the emergence of creativity; this embracing context incorporates social creatures, their perspectives, their attitudes, their cultural stance, and the physical space of their actions. Although such creativity has been expressed in many different ways of understanding, the significance of the creative environment has been widely acknowledged in the creativity field (e.g., Amabile, 1989; Baer & Kaufman, 2005; Csikszentmihalyi, 1996; Daniels, 1997; Davis, 1997; Kemple & Nissenberg, 2000; Torrance, 1977). This shift in creativity research engendered a new point of view on creativity that demonstrated how creative endeavours are rooted in social works and how new ideas emerge in a collaborative climate (Sawyer & DeZutter, 2009).

Hargadon (2003) claimed that a complicated interaction is almost always the basis of considerable creations. Previous studies have focused on creative individuals, finding that interactive works have a great influence on their creative ideas, when researchers examined the impact of social and cultural sources on creative persons (Csikszentmihalyi, 1996; Farrell, 2001; John-Steiner, 2000). Cropley (2006) argued that the recent reflection of creativity imagery is apparent as a mechanism for personal appearance, self-awareness, and self-fulfilment. Yet, Cropley suggested that another manner in which to explore creativity and creative settings centred on the social interactions around the creative endeavours, in which creativity is supported not separately as isolated efforts, but rather fostered by social networks as groups work cooperatively. In Csikszentmihalyi's (1990) model, creativity is not purely an objective possession; it is a consequence of social interactions between a person and the atmosphere in which he or she interacts. The human potential can be fostered by a structure of social interactions in techniques that enable individuals to add to, rather than deduct from, the process of being a favourable attendance to schools and those they educate (Novak & Purkey, 2001).

The environment appears to be the incubational context of creativity for some theorists and researchers, who believe that a creative personality cannot be formed, a creative process cannot actively occur, and creative products cannot be generated without an appropriate and supportive environment. In terms of the four elements of creativity, the literature also spotlights different paths to understanding creativity by discussing the C models of creativity.

3.2.2 The C models of creativity

Creativity and innovations during the last 50 years have been addressed in investigations by focusing on instantly recognisable examples (Beghetto & Kaufman, 2007; Runco, 2004). Craft (2002) indicated that many studies have focused on undoubtedly extraordinary examples of creativity. Such creativity is sometimes called high creativity (Craft, 2002), big C creativity (Beghetto & Kaufman, 2007), or historical creativity (Boden, 1990). The big C creativity model is focused on novel contributions that add something to human history and develop one of the contexts with which humans are concerned. Big C creativity clarifies the importance of the final outcome of this type of creativity; it demonstrates novel achievements recorded in human history for the first time. In other words, the big C concept suggests that creative people change history by adding something new and useful. For example, Gardner (1993) studied seven examples of big C creativity by exploring the personality and the biographical factors of well-known people such as Freud, Einstein, Picasso, Stravinsky, Eliot, Graham, and Gandhi. The study found much useful information about the examples, highlighting the similarities among them associated with big C creativity. Nevertheless, the study was criticised because it limited an expanded concept (i.e., creativity) to only a few extraordinary people who demonstrated high abilities. For example, Beghetto and Kaufman (2007) commented Gardner's work:

> Although such work has provided important insights into personological, environmental, and social factors of creativity, focusing only in eminent forms of creative production precludes the study and understanding of more common forms of creativity. Moreover, such narrow conceptions of creativity fuel problematic beliefs and stereotypes about the nature of creativity. (p. 74)

Many researchers in the creativity field have acknowledged that creativity is not a concept associated with only extraordinary people, asserting that creativity is associated with all people (Sternberg et al., 2004). Thus, another model of creativity is needed to clarify the everyday creativity observed by researchers. This model, called little C creativity, which focuses on everyday activities whereas big C creativity focuses on outstanding creative contributions.

Craft (2002) discussed little C creativity and argued that this notion is concerned with the use of intelligence, imagination, self-creation, and self-expression. It is not based on product-outcome or novelty production, but rather personal effectiveness that concentrates on the well-being of individuals. Craft (2002, p. 43) said that little C creativity is a sort of "personal effectiveness in coping with recognising and making choices, above and beyond what has been needed hitherto". Individuals using this kind of creativity aim to develop their lives by developing better choices that in turn can affect others' lives. In addition, it can affect wider contexts, such as social, economic, and educational contexts. Craft (2002, pp. 57–58) summarised five features found in both big C and little C creativity: fashioning new things, risk-taking, having deep knowledge and understanding in a particular field, engaging the audience in recognising the creativity and its value, and viewing creativity as an idiosyncratic concept. Yet Craft (2002) also highlighted the differences between the models by clarifying the focus of each—namely, changing one's personal life in little C compared to changing a field of endeavours in big C. The two approaches also differ according to the field in which creativity is evaluated; in the little C, for example, peers and non-experts can evaluate creative actions, whereas in the big C field, experts should evaluate the action and make judgements about it.

A few years ago, Beghetto and Kaufman (2007) argued for further development of the creativity framework by drawing a third C creativity model: mini C creativity, which is "the novel and personally meaningful interpretation of experiences, actions, and events" (p. 73). According to Beghetto and Kaufman (2007), the mini C is a consequence of the conceptual development of both big and little C creativity; it is also a self-production approach that leads to unique interpretations of any external information. These unique interpretations differ from one person to another because people's interpretations are based on personal experiences, existing concepts, and distinctive history. According to Beghetto and Kaufman (2007, p. 75), "the reason why we believe that mini-c is a construct that deserves its own terminology is because current conceptions of little-c creativity are not inclusive enough to accommodate the personal creative processes involved in students' development of new understanding and personal knowledge construction".

Furthermore, Kaufman and Beghetto (2009) expanded the creativity models by justifying a fourth one, known as the professional creativity model (pro C). This model mediates the big and little C models. Kaufman and Beghetto asserted that certain people are creators in their field of specialty; however, they are not as famous as highly creative people (i.e., creators of big C). "Pro-c represents the developmental and effortful progression beyond little-c (but that has not yet attained big-C status). Anyone who attains professional-level expertise in any creative area is likely to have attained pro 'c' status. Not all working professionals in creative fields will necessarily reach pro 'c'. … Similarly, some people may reach pro 'c' level without being able to necessarily quit day jobs" (p. 5). As a result, this model draws attention to professional expertise, which Kaufman and Beghetto argued requires 10 years or more of experience in the specialty domain. They also argued that it is possible to jump the pro C level, moving from little C to big C.

It seems that the notion of creativity is characterised by diversity and multiple purposes; no single meaning, description, or explanation of features exists to create a universally accepted definition. These multiple meanings and understandings of creativity differ because they have been built on different theoretical approaches used to study creativity, and these approaches comprise several theories and techniques. Notwithstanding, it is imperative to perceive the advantages of these various creativity explanations. Treffinger (1986) asserted that these theories have been associated with creativity, yet no single theory has been universally accepted as a theory of creativity. However, this does not indicate a weakness of such theories; rather, it demonstrates the nature of creativity as a multifaceted concept. Some theorists have argued for different theories and approaches for creativity rather than a unified one because the variety enriches people interested in creativity by providing multiple explanations and understandings.

Especially in the educational domain, researchers and educational practitioners could discover that certain theories are suitable for different contexts (Craft, 2001, 2002; Pope, 2005). Therefore, trying to define a single best theory of creativity is more likely to be a pointless effort that only diminishes the possible explanations of creativity. As Dacey concluded, “I doubt whether it makes much sense to argue which of them is right and which is wrong … they remain in such a speculative state that nothing but an endless argument is likely to result” (1989, p. 53). Hence, I shall explore some of these major theories for the sake of understanding the historical development of creativity as a research subject and to clarify the differences and connections between these theories and the sociocultural approach adopted in this research.

3.3 Theoretical Paradigms of Creativity

Early 20th-century research in the psychological domain contributed considerably to the field of psychology; however, creativity appeared to be a neglected field compared to other psychological fields (Guilford, 1950). Sternberg and Lubart (1999) declared that, although creativity has been an attractive field to researchers since the early 1950s, the development of creativity has not been considered a core domain in the psychological fields until recently. Sternberg and Lubart explained how creativity is associated with psychology by exemplifying several psychological theories that are not equally current; however, it is important to mention here, that most of these approaches are still adopted by scholars of social science. Accordingly, I have reviewed some of these approaches.

Historically, the mystical approach perceived creative people to be inspired persons who received divine inspirations to create their exceptional ideas or outcomes, such as a piece of poetry. Such an approach considered that creative outcomes emerged without the creator’s endeavours, but rather due to spiritual power (Cropley, 1999). The ancient Greeks connected creativity with the gods; they believed that all desirable innovations were inspired by the gods or by God (Dacey, 1999, p. 310). For example, Plato considered poetry to be a muse order; he and Socrates believed that divine madness was the producer of creativity (Albert & Runco, 1999).

Although the divine madness is still popular approach, some people replaced divine justifications with practical explanations and believed that there are universal and natural laws that control the universe and human development. This conceptual shift generated what is known today as the pragmatic approach. As a result, some scholars were able to understand the universe without religious or spiritual powers and involvements (Albert & Runco, 1999).The pragmatic approach is characterised as a practical approach concerned with developing creativity by focusing on associated aspects of creativity. Nevertheless, it was argued that the pragmatic approach is not seriously concerned in validating its perspectives of studying creativity (Sternberg & Lubart, 1999), because the practicality of this approach does not based on validated theories.

Furthermore, the psychodynamic approach views creativity as an outcome of complex interconnections among the unconscious forces and conscious actuality. According to this approach, creativity occurs through a two-step process, moving from adaptive regression to elaboration (Kris, 1952, as cited in Sternberg & Lubart, 1999, p. 6). According to Kris, the former refers to the interference of unadjusted ideas that might occur when solving a problem or insensible situations (e.g., daydreams, sleeping time, and intoxication) whereas the latter refers to the transmission of the unadjusted ideas to real orientations. However, other theorists have argued that a mediated process exists between the unconscious and conscious stages—namely, the preconscious one. For example, Kubie (1958, as cited in Sternberg & Lubart, 1999, p. 6) believed that this mediated process (i.e., preconscious process) is the basis of creativity in which unadjusted ideas are interpreted. The limitation of such an approach is associated with its studied samples because it stands on cases of socially accepted creators (Sternberg & Lubart, 1999). This limitation results in difficulties in applying such an approach to study creativity in wider context; where the creativity of normal people (i.e., socially unknown as creators) are more likely to not be cases for studying creativity.

The psychometric school has also focused on studying creativity; this approach facilitated the investigation of creativity by asserting that it can be studied in everyday subjects (Guilford, 1959). The psychometric researchers focused on individual creativity and considered it to be a set of personality traits. As a result, some researchers created several divergent thinking practices to measure creative thinking and assess creativity (i.e., Guilford, 1959). Similarly, Torrance (1974) developed creative thinking tests consisting of problem solving and divergent thinking tasks that can be scored for flexibility, fluency, and originality. Sternberg and Lubart (1999) also summarised opponents’ criticisms of this approach, including the criteria of creativity being a debatable issue, the ignoring of real examples of creativity, and unknown samples that do not represent socially accepted creators.

The cognitive approach highlighted the mental representations and their processes. The approach includes two phases: the generative phase, which comprises properties that motivate creative discoveries, and the exploratory phase, in which these properties are applied to produce creative thoughts (Sternberg & Lubart, 1999). These properties are mental processes, such as coding, storing, retrieving information, and producing novel ideas (Cropley, 1999). Cognition theorists relied on associationism and Gestalt psychology and computational modelling (Smith et al., 1995), leading to two different investigative styles. For example, researchers who followed associationism and Gestalt psychology argued that particular mental abilities and cognitive skills are linked to creative thinking skills, such as insightfulness, incubation, intuition, the recollection of previous experience, divergent and lateral thinking and other cognition processes, which can emerge in human participation in daily activities (Smith, Ward, & Finke, 1995). Meanwhile, adopters of computer modelling, such as Boden (1999), studied creativity based on computer stimulations in which researchers can examine participants' creative response to problem-solving tasks through virtual settings.

However, a number of researchers were not convinced that personality traits can represent sufficient understanding of creativity. They claimed that creativity can be better understood by adopting a social–personality approach, which focuses on individual and social variables as foundations to creativity. Sternberg and Lubart (1999) referred to several studies that focused on personality traits such as intrinsic motivation, independence, confidence, risk-taking, and complexity. They also referred to studies that focused on social environmental sources of creativity, such as external supports, diversity, and individual background. The social–personality approach enabled researchers to combine different levels to study creativity. Moreover, other researchers claimed that creativity should be studied through two or more approaches at the same time, called the confluence approach. Sternberg and Lubart (1999) clarified the confluence approach that combines two or more of the previously mentioned approaches. Such an approach has become preferred in the study of creativity due to its complexity (e.g., Amabile, 1996; Csikszentmihalyi, 1996).

Notwithstanding, it could be argued that creativity has been deeply studied by investigating the role of the cognitive process and individual traits, which contributed to understanding creativity. However, such investigations have limited the concept of creativity to a self-centred model in which a person is the centre of everything. Perhaps, the reason for this was that a majority of creativity researchers adopted the individual model because they were psychologists (Montuori & Purser, 1995; Rudowicz, 2003). Indeed, diverse psychological areas could be examined based on explicit or implicit theories (Runco, 1990; Sternberg, 1985). Sternberg (1985) distinguished between two conventional and superior spheres to study creativity: explicit and implicit theories. Regarding explicit theories, specialists and psychologists have examined creativity to test their own assumptions (e.g., Niu & Sternberg, 2002; Rudowicz, 2003; Sternberg & Lubart, 1985), such as cognitive, psychometric, psychodynamic, and pragmatic approaches. On the other hand, studies that investigate the beliefs of specialists, psychologists, ordinary individuals, or others about creativity are based on implicit theories, such as social–personality and sociocultural theories. Implicit and explicit approaches are valuable and contribute to understanding creativity (Niu & Sternberg, 2002). As Rudowicz stated, "Implicit theories are argued to be of great theoretical and practical importance as they are helpful in formulating the common cultural views on creativity and in understanding what people in a given community mean when referring to creativity" (2003, p. 275). Furthermore, such theories can act as local principles which have convenient values in evaluating and assessing ourselves and others and can be used as a practical starting point for training (Runco, Johnson, & Bear, 1993; Sternberg, 1985). Thus, this chapter should discuss how creativity is perceived by the adopted approach—that is, the sociocultural approach. In the next section, the sociocultural approach is discussed and justified in more depth.

3.4 Sociocultural Approach to Creativity

The sociocultural perspective has a different view of creativity than other perspectives because it views all psychological phenomena including human's creativity in social and cultural context. Also, it draws mutual link between individuals' actions and their context. Accordingly, creativity contributes in building up the future development of individuals as well as their cultural context. For example, individuals learn from their culture by sharing its artificial tools and symbolic artefacts in their interpersonal interactions; and then, they can become creators of their personal future and developers of their cultural context by creating new innovative artefacts and tools.

Thus, creativity can be seen as a humanity requirement and a natural aptitude that has permanence values that ensure the development of individuals and cultures (Albert, 1990). A case in point, Csikszentmihalyi (1996) compared genetic cultural evolutions and recognised a similarity between them by asserting that memes (i.e., cultural information units) play a role in changing and developing cultures that is similar to the role of genes role in biological evolution. These units are transmitted through generations, then refined and changed to have appropriate units that guarantee the continuation of humanity (Csikszentmihalyi, 1996; Rudowicz, 2003) Thus, the aim of survival requires that people of a particular culture learn and develop their cultural units or memes. The development and change of these memes are creative outcomes that mutually connect the mental processes of people and the information units of culture. Thus, Csikszentmihalyi (1999) argued that creativity cannot be comprehended through an individualistic model only; rather, creativity must be studied through a sociocultural plane that perceives the mental process of individuals as segments, not as the whole of creativity.

According to Smolucha, “creativity exists not only where it creates great historical works, but also everywhere human imagination combines, changes, and creates anything new” (Smolucha, 1992 p. 54). Such a statement indicates that the sociocultural theory identifies creativity in everyday activities administered by intellectual actors that lead to individual and cultural effectiveness and usefulness. In other words, the sociocultural theory is not only concerned with historical productions of well-known people; rather, it is concerned with the human activities that refine and enhance their interactions to ensure continual personal and cultural development. Häyrynen (2009) agreed that creativity is an innate element of human practice and heritage; it is not an exclusive practice, assigned only to a small number of persons. Thus, Smolucha said, “in this sense all that is the work of the human hand, the whole world of culture, is distinguished from the natural world because it is a product of human imagination and creativity based on imagination” (1992, as cited in Moran & John-Steiner, 2003, p. 11). In this respect, any new creation is culturally inherited from social interactions and practices among individuals who share culturally mediated artefacts in order to create new mediated artefacts to support present and future lives. As Moran and John-Steiner (2003) concluded, “creativity creates a lifelong zone of proximal development for adults to continually learn from and contribute to their cultures. It helps people actively adapt themselves to the environment and modify the environment to themselves” (p. 18). This means that there is a mutual relationship between culture and individuals in which creativity is situated. Therefore, the sociocultural theory does not focus on individual traits or pre-existing products to study creativity; rather, it focuses on the interaction among individuals mediated by cultural signs.

> Through such interaction, creativity actualises the inherent, latent possibilities of people and environments; it not only broadens what we singly and collectively have done, but also what we can and may do. It allows people to step out of the present moment, reflect on the past and plan future behavior; it connects us to what could be. Through the development of creativity, a person comes to be a flexible, intentional inventor of his or her personal future and a potential contributor to his or her cultural endowment. (Moran & John-Steiner, 2003, p. 5)

Furthermore, Vygotsky (1978, 1987), John-Steiner (2000), Moran and John-Steiner (2003), and Sawyer (2003, 2008) explicated the appearance of creativity in shared procedures, conversations, mutual labours, creative communication, and group works between individuals. As a result, recent researchers have emphasised that several features of the sociocultural theory are connected to creativity research, including Tulviste (2001), Moran and John-Steiner (2003), and Sawyer (2008), who demonstrated the significance of human interaction with the surrounding context and its internalisation and externalisation process that enlightens the relationships between individuals and influential cultural elements. Vygotsky (1978, 1987) viewed individual development as a device of the cultural effort; culture penetrates the mental functioning of individuals through culturally mediated signs and begins to work as an internalised process. The internalisation is not simply an imitating process, but also transmits and distinguishes received knowledge, comparing it with previous experience. Vygotsky also highlighted the externalisation process as well as the internalisation one; individuals interact with others or with objects through mediated signs to enhance and create new cultural tools.

The cultural tools or signs that mediate human activity can refer to all the human production that differs from the natural world; Ludwig (1992) clarified culture as a combination of all beliefs, ethics, actions, laws, policy, economy, technology, and traditions of a group of people in a particular time and place. These cultural forces can play a role in the degree of activity effectiveness, resulting in a number of researchers advising of the need to consider the cultural influences that connect human activity. For example, John-Steiner (2000) investigated the social interactions and discussions of socially well-known creators and found that insightful processes emerged from them. According to Feldman (2000), although the creative outcomes of well-known people (e.g., Darwin and Einstein) might be individually produced, Vera John-Steiner has indicated the valuable role of collaboration and social support in these well-known human productions. Moreover, Lubart (1999) and Rudowicz (2003) argued that the cultural environment is one of the bases for promoting or discouraging creativity. He argued that the relationship is dynamic because such sociocultural values are not only socially gained and transmitted from generation to generation, but are subject to change through time. Csikszentmihalyi (1999) asserted that, to study individual beliefs and perspectives about creativity, the environment in which an individual operates should be a starting point and significantly addressed; this environment comprises two “salient aspects”: the cultural, or symbolic, aspect, and the social aspect (Csikszentmihalyi, 1999, p. 314).

The cultural and social relationships of a particular community should be a fundamental focus to understand creativity and how people evaluate its usefulness, appropriateness and novelty, especially when cultural tools or signs used by people in their social activities might differ from one culture to another. Underestimating the cultural role that penetrates social activities could form a deficient picture of creativity in a particular culture, which is why recent theorists and researchers have begun to emphasise the need to view creativity from sociocultural perspectives. For example, Craft (2010) mentioned the emergence of cultural perspectives of creativity in the 21^{st} century when she indicated that there was growing acknowledgement that creativity should be understood through its cultural background. It is problematic to view creativity only from a Western perspective, especially in the educational and psychological fields (Craft, 2005, 2008, 2010). One reason for this is that sociocultural principles “may influence the overall level of creative activity. Creativity may be stimulated or hindered by cultural features such as worldview and value placed on conformity or tradition” (Lubart, 1999, p. 345). Thus, the current study adopts the sociocultural approach to investigate science teachers’ pedagogical beliefs about and practices that perceived as approaches to foster creativity in science classes in Kuwait. The next chapter discusses science teachers’ beliefs and pedagogical practice based on theoretical and empirical reviews; however, I first talk about the position of creativity in the educational field before discussing science teachers’ beliefs and practices.

3.5 Creativity in Education

3.5.1 Importance of creativity in education

In recent years, creativity has become an educational priority for several reasons. It has been acknowledged that the connection between creativity and education is increasingly significant (Craft, 2002, 2005, 2010; Gibson, 2010), especially when such a relationship is supported by extrinsic non-educational forces of other domains. Creativity per se has been heralded as a means by which to solve a plethora of social, political, and economic problems facing the 21st century (Gibson, 2010, p. 607); such problems seem to be a result of the gap between educational outcomes and long life requirements. This gap is fashioned as a result of impeding creative development of learners within educational settings. For example, Torrance (1967), who was concerned with the extreme difficulty of predicting and visualising particular tribulations that could be supreme in the future, pointed out that the contemporary approaches of understanding life and solving problems would not be adequate for unpredicted tribulations in the future.

Thus, preparing individuals and prompting their creativity to be ready to challenge unpredicted problems is a vital issue. “Things are changing so rapidly that we can no longer survive, if we insist on thinking and living in static terms. … We cannot afford to return to the old ways. … We must accept the creative challenge” (Torrance, 1967, p. 330). Moreover, Cropley (2001) argued that educational instructions limit their role in transmitting knowledge and skills to students, which change and become useless through time, while the skills and knowledge needed for the future are not predictable and expectable. Thus, he argued for nurturing creativity by promoting flexibility, openness to new ideas, the ability to adopt or view unusual ways of doing things, and the ability to take risk when facing the unexpected rather than transmitting knowledge and skills that will be obsolete in the future. This argument indicates that educational goals and practices that focus only on knowledge and skills acquisition might lead to a deficit in dealing with future problems which have not been expected and transmitted to students during the educational period. Consequently, a question could be raised about the responsible drivers that strengthen the relationship between creativity and education.

Recently, Craft (2010) highlighted three main drivers that transferred creativity to an educational priority: economic, social, and technological drivers. Regarding the economic driver, there is an international tendency to increase educational accomplishment levels to benefit future economic development by developing the skills base and generating a skilled workforce to fit the requirements of the economic field (Jeffrey, 2006). The speed of economic development has significantly increased the value of creativity in education because it creates new forms of work or employment, which did not exist when the employees and workers were at school. Therefore, Craft (2010) stated that “the economic futures of those entering school today are even less predictable, requiring of them (and their teachers) a capacity to innovate and to respond flexibly to uncertainty” (p. 21). This argument is in line with Cropley’s (2001) argument about preparing students to deal with new paths that stand on unusual skills and knowledge in their future to avoid impeding economic development; as Craft said that “creativity is required to keep the economy changing fast enough to keep up this consumerism” (2010, p. 21).

In contrast, the social driver is concerned with personal choices because it is a fundamental value for social engagement and interaction among people, especially when demographic changes occur continuously. Students should have the opportunity to distinguish the possibilities and make sense of an assortment of choices that face them in the future (Craft, 2010). Finally, the technological driver—the rapid change in the technological domain in individual lives as well as organisations—offers a chance for individuals to demonstrate creative levels in dealing with digital technology. Students, as current and future users of technology, need to employ their creative and imaginative thoughts to interact with digital devices and raw materials offered through it.

In addition, these major drivers are connected to others, such as ecological and spiritual drivers (Craft, 2010). I would argue here that Craft’s argument appears to support the adoption of sociocultural perspective to study creativity, especially in the educational field, because such external influences can be the criteria or the scale used to evaluate individual effectiveness in the future. Thus, external drives draw attention to the need to prepare students with high personal effectiveness to deal with unexpected contexts in their future and build up their cultures.

3.5.2 Creative Education

It is necessary to first understand the educational perspectives of creativity. The complexity of creativity can be viewed educationally through three conceptual scopes: teaching creatively, teaching for creativity, and creative learning. As Ripple (1999) said, creativity in education is a mixture of capabilities, skills, perspectives, stimulation, and other factors. Thus, distinction is needed among the three concepts to comprehend creativity in education. Teaching creatively and teaching for creativity can be recognised through individual orientation, such as the teacher's orientation spotlighting creative teaching or teaching creatively while the student's orientation emphasises teaching for creativity (Cremin, 2009).

> Creative teaching is seen to involve teachers in making learning more interesting and effective and using imaginative approaches in the classroom. Teaching for creativity by contrast is seen to involve teachers in identifying children's creative strengths and fostering their creativity. (Cremin, 2009, p. 36)

Nevertheless, such a distinction has not been made through empirical investigation; rather, it has been developed based on a report from the National Advisory Committee on Creative and Cultural Education (NACCCE, 1999). The NACCCE (1999) report distinguished between teaching creatively and teaching for creativity by generating characteristic differences. The former is defined as "using imaginative approaches to make learning more interesting and effective" (p. 89). The latter is defined as ways of teaching that are concerned with nurturing student's creative abilities and behaviours. Jeffrey and Craft (2001) addressed a possible interpretation of the NACCCE statements—namely, that the teaching creatively might be assumed to be more associated with "effective teaching" whereas teaching for creativity is associated with empowering the creative potential of students. In addition, the NACCCE (1999) report explicated that "teaching for creativity involves teaching creatively" (p. 90) and stated that students' creative abilities are more likely to be clear and obvious when the teacher's creative abilities are engaged in the classes. Nevertheless, such a distinction could lead to a risky dichotomy, such as formal and informal teaching, which has been criticised as a source of producing limited pedagogic principles; therefore, the relationship between the two concepts should be empirically explored (Craft, 2005).

Although the NACCCE (1999) report tried to distinguish between teaching for creativity and teaching creatively, it showed that the two concepts are integrated in terms of classroom practices. Thus, Jeffrey and Craft (2004) examined this relationship by focusing on empirical study from an early year's school known for its creative approach. The assessment adopted four features of creativity and pedagogy identified by Peter Woods (1990)—relevance, ownership, control, and innovation—to show the interdependence of the NACCCE distinctions. The findings revealed that "the relationship between teaching creatively and teaching for creativity is an integral one. The former is inherent in the latter and the former often leads directly to the latter" (p. 83). The two concepts seem to intervene with one another; for example, if a teacher wants to foster his/her students' creativity, his/her activity might require creative and original teaching practices not known and recognised by the students. Such original practice could lead to original and creative reaction from the students because, in this case, they have been situated in unusual activity. Meanwhile, the students' interaction and correspondence with creative teaching and teaching for creativity might reflect the creative learning concept. Jeffrey asserted that "our interest in 'creative learning', focused on how creative teaching was experienced, adapted, appropriated or rejected by students and what kinds of creative agency is released through creative teaching contexts" (2006, p. 401).

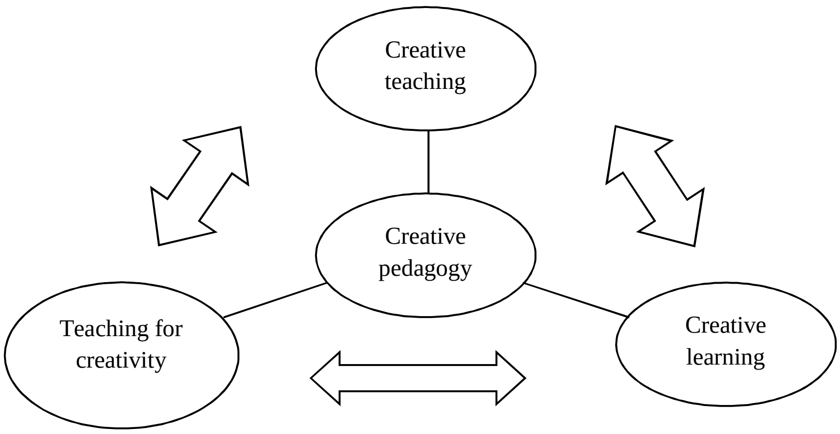


Figure 5: Three elements of creative pedagogy (Lin, 2011)

Although the current study focuses on pedagogical beliefs and practices of science teachers in terms of fostering students' creativity in school science, the intervening relationship among these concepts, as illustrated in Lin's diagram (2011) in Figure 5, should not be neglected when collecting and analysing the data.

Having reviewed the relationship among these educational concepts of creativity, I now demonstrate the three major aspects perceived to be components of fostering students' creativity in the classroom. Research from the last 50 years has indicated several pedagogical approaches, strategies, or aspects that foster creativity. Such aspects did not pass on dramatic change movements; rather, little changes emerged through the development of creativity research. According to Plucker et al. (2004), possible practices of creativity have been recognised in empirical investigations throughout the last few decades. Nonetheless, future practices are hardly ever documented. Researchers' understanding of creative thinking and learning has greatly developed over the last few decades, yet their approaches for fostering creativity have altered very little (Plucker, Beghetto, & Dow, 2004). This does not mean that pedagogical aspects that foster creativity are limited or deficient because the literature demonstrates various practices that foster and encourage creativity in classrooms.

> Most theorists do postulate strategies, processes, or habits of mind that make creative ideas more likely. These may include generating analogies, defining problems, or looking for multiple solutions. It is possible that such strategies can be taught and improved. (Starko, 2001, p. 66)

Thus, I shall highlight the literature on pedagogical aspects that seem to be requirements for fostering the creative potential of students. Lin (2011) summarised theorists' views about fostering creativity in education by categorising and inspecting three aspects: teaching, environment or context, and teacher principles.

3.5.3 Major aspects to foster creativity in education

3.5.3.1 Teaching

This aspect highlights the teaching practices which appear as creative and original practices or encourage the development of students' creativity. Several teaching programmes and techniques are believed to develop creativity. Cropley (2001) mentioned some of these practices based on idea-generating techniques, such as brainstorming, creative problem solving, morphological method, hierarchical method, imagery training, and mind maps, as well as on instructional approaches, such as buzz groups, flexastudy, lateral thinking, bridge building, idea production, SCAMPER, and CoRT Thinking programme. However, Cropley (2001) stated that, although these approaches and other creativity programmes are well presented and easily readable, criticisms can be made about their feasibility and workability claims. For example, Hruby (1999, as cited in Cropley, 2001) argued that the drawbacks of these approaches include dealing with assumptions and suppositions as fundamental facts, viewing correlations as cause-and-effect connections, making generalisations without supporting empirical findings, and claiming workability regardless of the characteristics of individuals participating in the activity, the circumstances of the context, or the structural factors in which the approach is applied. Thus, Cropley (2001) called for researchers to consider all factors and offer a holistic approach that focuses on cognitive aspects of the students, their motivation and personality, and their interaction with the environment.

It is true that Cropley suggested that practitioners and educators should evaluate their classroom practices through the holistic model or approach. Nevertheless, he did not attempt to support the model with evidence-based research. On the contrary, there was an increased concern to foster students' possibility thinking, which could be seen as the heart of everyday creativity. Craft (2000, 2001) suggested that possibility thinking is the central component of creative learning seen from three levels (e.g., agents, process, and domain). Possibility thinking is embedded in the students' participation in which students pose "what if?" questions, such as "what can I do with this?" instead of "what is this and what does it do?" (Craft, 2001). In 2006, the core elements of possibility thinking were empirically documented by Burnard, Craft, & Grainger (2006), including seven aspects: posing questions, playing, being imaginative, demonstrating innovation, taking risk, showing self-determination, and immersing and making connections. Consequently, an empirical model of pedagogy for possibility thinking was developed by Cremin, Burnard, & Craft (2006; see Figure 6) and followed by empirical investigations of pedagogical practices to foster possibility thinking in the early years (e.g., Burnard, Craft, Cremin, & Chappell, 2008; Chappell, Craft, Burnard, & Cremin, 2008a & 2008b; Craft, Cremin, Burnard, Dragovic, & Chappell, 2012a; Craft, McConnon, & Matthews, 2012b; Cremin et al., 2006).

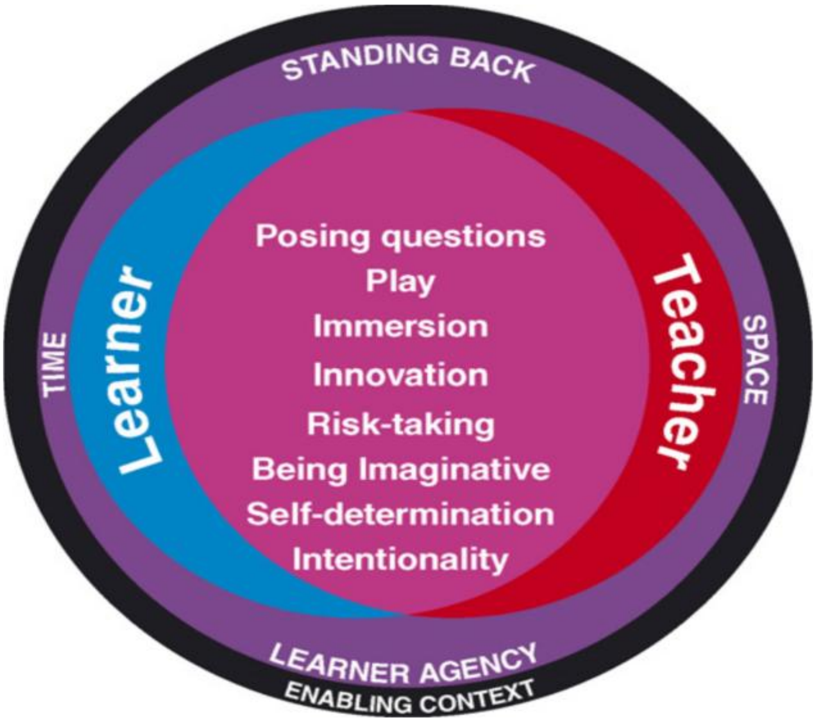


Figure 6: Model of pedagogy and possibility thinking (Cremin et al, 2006)

In the last few years, studies have aimed to document empirical evidence of possibility thinking pedagogy, making the model more applicable and valid than previously mentioned techniques criticised by Cropley (2001). Hence, teaching approaches are varied and different, but they can embrace similar teaching principles or similar elements that should be fostered. These teaching approaches are also connected with the teacher principles and the context in which the activities occur.

3.5.3.2 Educational environment

Regarding the environment, a large number of researchers and educational practitioners have advocated that the classroom context and its activities play a fundamental role in fostering creativity (e.g., Bassett, 2004; Davis & Rimm, 1998; Saracho, 2002; Sternberg & Williams, 1996). They justified their positions based on the fact that prompting creativity requires a friendly and receptive context that supports students' freedom and encourages their thinking to generate unusual ideas and thought (Davis & Rimm, 1998). The pedagogical practices should be designed with respect to students' interactions and interests, so teachers' practices need to create a sphere in which students can engage freely with the activities. Offering a space for students to act freely and participate is one of the core elements of fostering creativity because it can support the chances for students to indicate their interests and sources of strength. According to Gibson (2010), creativity in classrooms is based on students' reaction when they actively engage with the classroom activities, demonstrating opportunities for inquiry-based learning, collaborative learning, and constructivism. Thus, cooperation and negotiation between the teacher and his/her students could lead to the promotion of creativity (Sawyer 2004). Consequently, fostering creativity in the classroom seems to require addressing the students' tendencies and interests to enable the emergence of such negotiation and cooperation among the teacher and students. Sternberg (2006) declared that, "when students are taught in a way that fits how they think, they do better in school. Children with creative or practical abilities, who are almost never taught or assessed in a way that matches their pattern of abilities, may be at a disadvantage in course after course, year after year" (p. 94). Therefore, drawing attention to fostering creativity might transform students from passive receivers to socially active participants who, in turn, develop their learning and personal effectiveness. As Cropley (2001) said, "creativity offers classroom approaches that are interesting and thus seem to be a more efficient way of fostering learning and personal growth in the young. *Creativity helps children learn and develop*" (p. 28).

3.5.3.3 Teacher principles

With respect to the third aspect, teacher ethos, teachers should have positive attitude towards creative efforts and be flexible as well as encourage individual thinking. For example, Haring-Smith (2006) argued that motivating students to take risk and be independent and free in their works are great aspects for pedagogy used to foster creativity. Ewing and Gibson (2007) agreed with these aspects and also added spontaneity, open-mindedness, and openness to experience as teaching requirements for creativity. Classroom activities that foster students' creativity are more likely to offer sufficient time for creative thinking, rewarding unusual thoughts, promoting students to take risk, facilitating the questioning approaches, and accepting mistakes (Sternberg & Williams, 1996).

It also takes into account students' interests and problems, producing various and diverse assumptions, highlighting the holistic view of the ideas and encouraging students to think about their thinking skills (Starko, 1995). Meanwhile, the classroom activities ought to avoid some aspects that demolish creativity, such as constrained opportunities, rivalry, stresses on students, and evaluation (Amabile, 1989). These aspects give the impression that they rely heavily on the teacher's role and responsibilities. Teachers who create a good relationship with their students and are keen to meet the students' requirements and interests are more likely to be creative teachers and supporters of fostering students' creative potential. Such teachers can establish creative connections between the learners and themselves by developing classroom activities and teaching techniques that foster their creative endeavours (Sternberg & Williams, 1996).

Therefore, teachers ought to embrace students' involvement as an integral part of the learning process by enhancing students' awareness about their fundamental role in the classroom activities as well as the teaching methods (Davis & Rimm, 1998). In addition, teachers are required to facilitate long-term tasks and motivate students to take risks with their learning to raise their tolerance for uncertainty (Sternberg & Lubart, 1991). Moreover, Cropley (1997) believed that teachers need to "consider information, special ways of thinking about it, inventiveness in finding solutions, ability to evaluate ideas, ability and willingness to communicate solution to others, and evaluation of solutions in the context of the real world" (p. 89).

3.6 Reflection on Creativity Literature

Creativity has been defined by multiple models and definitions, yet no globally accepted definition exists. Such multiple definitions reflect the complicated nature of creativity, including the dissimilar theoretical explanations of it. Nevertheless, this research adopts a sociocultural framework because this seems to be the most comprehensive explanatory framework. Also, this research argues for implicit theory in which people of a particular place in a particular time define creativity. Furthermore, the sociocultural approach asserts that creativity can be found in everyday activities in which the mental processes of participants interact with sociocultural sources via mediated tools and artefacts. These activities are a creative effort because they are a human production, meaning they can be performed not only by well-known creative people, but also by any person to develop his/her future (little C creativity). As a result, advocates of this approach focus on sociocultural influences to explain creativity in everyday activities. As previously mentioned, beliefs, values, ethics, and practices of individuals in a particular community are the cultural artefacts or tools that connect the participants and a sociocultural resource to form an activity. This reading of the literature suggests that pursuing people's beliefs about creativity and their actual practices to demonstrate creative outcomes in their activities is a key issue for understanding creativity in a specific cultural context. Consequently, the current research aims to discover the pedagogical beliefs of science teachers about fostering creativity in classroom activities in the Kuwaiti context as well as discover the pedagogical practices used in the classroom activities. I earlier introduced the people's needs for creativity in their lives and their education; this introduction comprised a general discussion of educational perspectives on creativity. The next chapter will discuss creativity and science teachers' beliefs and practices in greater depth.

Chapter Four: Teachers' beliefs of and practices for fostering creativity in science classrooms

4.1 Introduction

The previous chapter focused on issues associated with creativity, including the historical approaches of studying creativity and the models of creativity; it also discussed the sociocultural perspective of these issues as they related to creativity. In addition, the previous chapter covered the importance of creativity in education and discussed educational issues regarding creativity, including the reasons for increased educational attention on creativity, the differences between teaching creativity and teaching for creativity, pedagogies and creativity in classrooms, and the role of the classroom teacher.

The current chapter further narrows the focus, providing a critical discussion of creativity in the science classroom. More specifically, literature related to teachers' beliefs about and pedagogical practices for fostering creativity in science classrooms is reviewed. The first main section discusses the definition of beliefs, the relationships between beliefs and knowledge, the relationships between beliefs and practices, and the sociocultural perspectives of teachers' beliefs and practices in order to provide a better understanding of the meaning of teachers' beliefs and practices and how they relate to sociocultural contexts. The second main section empirically highlights and critically reviews literature related to fostering creativity in the science classroom, including creativity and the nature of science and science education, pedagogical approaches for fostering creativity, sociocultural factors that facilitate or limit teaching for creativity, and science teachers' beliefs of and practices for creativity. The chapter concludes with a reflection on the literature review covered in the current chapter.

4.2 Teachers' Beliefs, Knowledge, and Practices

4.2.1 Nature of teachers' beliefs

Beliefs have been defined and explained by various researchers and theorists, leading to differences and multiple interpretations. The generated differences of these previous works diverge into surfaces such as the terminological surface, measurement surface, and natural surface of beliefs. Eisenhart, Shrum, Harding, and Cuthbert (1988) concluded that there is no unified and settled definition of beliefs. Indeed, some theorists have defined belief as people's comprehension of themselves and the milieu in which they live. Pajares (1992) recognised belief as individual guides that assist people in understanding and perceiving the universe as well as themselves. Meanwhile, Pratt (1992) asserted that beliefs are particular connotations people hold about phenomena that intervene in their interactions with contexts relating to those phenomena. According to Pratt, people shape beliefs about every feature of the perceived universe; "in doing so, [they] use those abstract representations to delimit something from, and relate it to, other aspects of our world. In effect, we view the world through the lenses of our conceptions, interpreting and acting in accordance with our understanding of the world" (p. 204).

Such definitions indicate that belief is an individual's expedient conviction that provides acceptable interpretations and elucidations about the person him- or herself or his/her surroundings; these expedient convictions could be fashioned through experience. Siegel, for example, viewed beliefs as a "mental construction of experience" (1985, as cited in Pajares, 1992, p.313). Nevertheless, some have claimed that beliefs are not only personal convictions, but might also occupy a greater position by mediating personal opinions and objective facts. For example, Loucks-Horsley, Hewson, Love, & Stiles (1998) stated that a belief is conceptually at a higher level than opinion but at a lower level than the perfect certainty acknowledged by people. This view assumes that belief is a sort of truth derived from not only experiential interpretations, but also factual interpretations (knowledge). As such, the literature fails to provide a consensus in defining beliefs. Indeed, scholars and researchers have acknowledged that defining beliefs is one of the most problematic tasks due to the complexity of the concept; one reason for such complexity is the surfaces in which researchers differ from one another, such as the use of interchangeable terms related to beliefs, how to measure beliefs, and the fluid status between beliefs and knowledge.

As previously mentioned, authors interested in studying beliefs have acknowledged that it is difficult to develop a unified definition due to terminology-related issues associated with beliefs. A case in point is that beliefs are investigated using interchangeable terms or headings. According to Hoz and Weizman (2008), the literature on philosophy, education, and psychology reveals that alternative and interchangeable terms of beliefs exist, such as "belief, thought, idea, attitude, perception, opinion, notion, basic principle, portrait, world view, image, epistemological belief, personal knowledge, subjective theory, perspective, philosophy, ideology, value, system of explanations, understanding and knowledge" (pp. 905–906). In addition, Pajares (1992) declared that one of the inherent limitations of studying teachers' beliefs is the fact that, in the literature, beliefs are presented with multiple terms and definitions. Thus, it is more likely to find other concepts or terms representing the meaning of beliefs, such as concepts, individual ideologies, philosophies, and values that formulate practice and demonstrate knowledge (Ernest, 1989, 1991; Thompson, 1992). Other studies have used terms such as opinions, attitudes, preconceptions, personal epistemologies, perspectives, concepts, principles of practice, and orientations to address teachers' beliefs (Kagan, 1992; Pajares, 1992). Although such multiple interpretations and meanings create a "messy construct", the literature provides an intersectional vision among these multitude definitions (Pajares, 1992, p. 307).

Notwithstanding, the current study does not distinguish beliefs from among other interchangeable terms; rather, the term *beliefs* is used to provide consistency throughout the research chapters. Several researchers have not made a preference among the interchangeable terms because they asserted that discriminating among these terms has impractical and unfeasible outcomes. For example, Nespor (1985) clarified that "there is no assertion of a claim for priority in the use of the term beliefs, nor does it seem useful to try to explicitly differentiate the use of the term here from the uses of the term in other bodies of research" (p. 10).

Pajares (1992) did not describe beliefs as a "messy concept" (p. 307) only because the different terms have been applied in studies. Rather, Pajares argued that the bigger problem is how to measure and observe beliefs in order to come up with an accurate definition. According to Leder and Forgasz (2002), examiners cannot concretely scrutinise beliefs, which should instead be deduced from individuals' actions and declarations. A decade earlier, Kagan (1992) and Pajares (1992) had similar explanations and recommended researching practices to deduce evidence of participants' internal thoughts, such as beliefs, declarations, concept maps, analysed behaviours, and language associated with their intrinsic thoughts.

As far as the interchangeability and measurement aspects of beliefs are concerned, it is necessary to discover the relationship between beliefs and knowledge, especially as some theorists indicate that beliefs can be perceived as a kind of truth as beliefs can be formed from factual bases (knowledge) (Loucks-Horsley et al., 1998).

4.2.2 Relationship between teachers' beliefs and knowledge

Theorists such as Pajares (1992) have addressed the need to distinguish between beliefs and knowledge, asserting that knowledge stands on objective truth whereas beliefs stand on assessment and judgement. A widespread perspective among theorists is that fact or sureness is related to knowledge while disputability is connected to beliefs. For example, Thompson (1992) asserted that,

> From a traditional epistemological perspective, a characteristic of knowledge is general agreement about procedures for evaluating and judging its validity; knowledge must meet criteria involving canons of evidence. Beliefs, on the other hand, are often held or justified for reasons that do not meet those criteria, and, thus, are characterised by a lack of agreement over how they are to be evaluated or judged. (p. 130)

However, theorists have acknowledged the interfacing relationship between teachers' beliefs and knowledge in terms of teaching and learning issues (Grossman, Wilson, & Shulman, 1989; Kagan, 1992; Nespor, 1987; Thompson, 1992). Consequently, researchers have embraced different conclusions illustrating that beliefs are a form of knowledge while knowledge is a form of beliefs.

For instance, Kagan (1992) argued that a teacher's professional knowledge can be considered more precisely as beliefs that have been acknowledged as fact through objective evidence or harmony of opinions. According to Kagan, a well-matched correlation exists among teachers' experiences in educational settings that demonstrate their beliefs as personal and professional knowledge; he clarified that, when a teacher's experience in the class setting develops, the knowledge simultaneously develops, thereby shaping a well-built belief system that controls the teacher's practices and decisions. Meanwhile, Nespor (1987) asserted that the beliefs can be considered as a structure of knowledge that could be called personal knowledge because beliefs are static and knowledge might change. Moreover, knowledge can be evaluated through certain criteria whereas beliefs cannot. Clearly, no agreement exists as to whether knowledge forms beliefs or beliefs form knowledge. Furthermore, Mansour (2008) put forth a third view to explain the relationship between teachers' knowledge and beliefs as an interactive relationship. Mansour (2009) stated that "the settled or developed teachers' beliefs act as an information organizer and priority categoriser, and in turn control the way it could be used. In the interactions between knowledge and beliefs, beliefs control the gaining of knowledge and knowledge influenced beliefs" (p. 28).

Regardless of which concept forms what, the three views agreed that a connection exists between beliefs and knowledge. According to Grossman et al. (1989), teachers repeatedly consider their beliefs as knowledge, which somehow forces educational researchers interested in exploring teachers' knowledge to concomitantly investigate their beliefs. Furthermore, Thompson (1992) supported the argument of educationists, who highlighted the inappropriateness of distinguishing between teachers' beliefs and knowledge; what is more significant is determining the extent to which or how teachers' beliefs or "personal knowledge" influences their actions inside the classroom. Based on Thompson's (1992) indication, the distinction between teachers' beliefs and knowledge is practically less important than its impact on teachers' practices.

4.2.3 Relationship between teachers' beliefs and practices

A large body of literature has demonstrated the idea that teachers' actions, judgements, management actions, and decisions could be a sequence of their beliefs (Nespor, 1987; Pajares, 1992; Richardson, 1996; Shin & Koh, 2007; Thompson, 1992; Woolley, Benjamin, & Woolley, 2004). According to Richardson (1996), a number of educational investigations have concluded that teachers' choices regarding their classroom activities and educational implementations are inspired by their beliefs. According to Mansour (2009), "a wealth of research evidence has shown that teachers' beliefs about teaching and learning science influence their teaching practices" (p. 30). Lissmann (2005) maintained that most teachers' classroom practices are the artefact of their beliefs. Berliner (2005) indicated the possibility of a relationship that combines teachers' beliefs and their practical decisions. According to Clark and Peterson (1986), a teacher's actions are significantly prejudiced and even established by the teacher's beliefs and thoughts. Teachers' beliefs are also a significant domain in which to view teacher decision-making activities and the effectiveness of educational practices (Nespor, 1987; Pajares, 1992). Indeed, educational activities can be manipulated by teachers' beliefs about learners, the subjects they teach, and their teaching commitments (Ashton, 1990).

However, some scholars hold a different view of beliefs' effects on actions by pointing out that such a connection is questionable. Although beliefs might direct procedures, "experiences and reflection on action may lead to changes in and/or additions to beliefs" (Richardson, 1996, p. 104). It seems that teachers' reflection upon their practices affect their educational behaviours. Duffy and Anderson (1984) highlighted the discrepancy between teachers' beliefs and implementations when they found that the intricacies of the classroom environment include compulsorily forces that compel teachers' instructional activities regardless of their beliefs. Such classroom intricacies affect the practical decisions that are in line with teachers' beliefs. Furthermore, Fang (1996) evaluated the discrepancies based on the literature and argued that the context is a source of inconsistency between teachers' beliefs and actions; he concluded that teachers' beliefs are formulated to educational actions only when their beliefs are allied with the classroom intricacy.

In addition, Roehler, Duffy, Herrmann, Conley, & Johnson (1988) acknowledged that teachers' beliefs might affect their behaviours and actions, although this is more likely to occur outside the school walls. The researchers stated that knowledge has a greater influence than beliefs on teachers' performance inside the classroom because knowledge genuinely spotlights the cognitive aspects of teaching. Roehler and his colleagues further argued that the current understanding of the belief–practice relationship can be precisely reflected through knowledge that is emotionally neutral and has a developing nature. Meanwhile, beliefs have a static, unchangeable nature and emotional impression. According to Roehler et al. (1988), teachers' practices in the classroom are a consequence of their beliefs being modified by their schooling experience; the role of knowledge here is to interpret and make sense of such experience. Consequently, it seems that multiple external factors mediate the relationship between teachers' beliefs and their practices; thus, the following subsection discusses the sociocultural view of teachers' beliefs and practices.

4.2.4 Sociocultural perspective of teachers' beliefs and practices

The sociocultural perspective is concerned with particular social, cultural, and chronological settings of development (Daniels, 2001) based on relationships among individuals, settings, actions, meanings, societies, cultures, and cultural signs (Wertsch, Río, & Alvarez, 1995). Such a perspective has drawn much wider attention to the importance of teachers' beliefs and practices, which are seen as cultural artefacts of mutual interaction between individual and external contextual forces. Research has acknowledged that teachers' beliefs and practices are not excluded from the contextual milieu in which teachers are active individuals who interact in culturally mediated activities and then internalise that external experience in their mental functioning (Ash, 2004; Robbins, 2005; Rogoff, 2003). These investigations found that sociocultural settings cannot be simply disregarded when exploring teachers' beliefs and practices because such beliefs and practices are positioned on settings consisting of external elements and influences, such as students, colleagues, educational experiences, academic background, school administration, and social and religious conventions.

According to Mansour (2008), researchers have acknowledged that teachers' beliefs are a constitutional focus to comprehend their practices within the classrooms. Researchers have argued that teachers' beliefs should not be discretely explored without referring to the environment in which the beliefs are located because environmental resources interact with these beliefs. Other researchers have argued that teachers' beliefs should be studied using a framework that addresses the cultural influences and forces in forming such beliefs. As Pajares (1992) explained, teachers' beliefs cannot be found in a vacuum and without contextual bases; therefore, addressing the relationships between their beliefs and the external contextual features is extremely significant. Nespor (1987) declared that the contexts in which teachers work and the external influences with which they deal are poorly defined and highly intertwined; thus, teachers' beliefs can make sense of these complex contexts. Furthermore, the contextual factors play a role by penetrating the relationship between teachers' beliefs and their practice, which in turn affects the consistency level of the beliefs and practices. Therefore, transforming teachers' beliefs into practices occurs based on different contextual elements (Ajzen, 2002; Lederman, 1992; Mansour, 2008).

These elements surrounding teachers' beliefs and practices are integral to developing a clear understanding of teachers' activities and practices inside their classrooms. As Olson (1988) declared, "what teachers tell us about their practice is, most fundamentally, a reflection of their culture and cannot be properly understood without reference to that culture" (p. 69). In this respect, teachers' beliefs about and practices related to "something" are influenced by and in relation to social and cultural environments. For example, Wells and Claxton (2002) revealed that the development of mental functioning can be nurtured through individual interactions with the surrounding aspects to select diverse patterns and habits that serve as guided structures for reconstructing the surrounding features in order to fit their present and future needs.

> Teachers' beliefs and the context in which their beliefs are developed and used should be taken into consideration in order to have a better understanding of how teaching and learning occur in classrooms and can thus be enhanced. Therefore teachers' own understanding of their work will elucidate how they make sense of their practices and how these perceptions affect their decisions about teaching and learning. … Teachers' beliefs are influenced by the interaction within the nested social contexts within which teachers' beliefs and practices are situated. (Mansour, 2009, p. 33)

Ultimately, in order to understand teachers' beliefs and how they construct their personal knowledge, it is crucial explore their personal experience with the contexts in which they interact; such an exploration will help understand and justify teachers' current practices in their classrooms (Butt, Raymond, McCue, & Yamagishi, 1992). This section provides the basis for investigating literature about science teachers' beliefs about and practices for fostering creativity. Therefore, the following section highlights issues with respect to fostering creativity in the science classroom.

4.3 Fostering Creativity in the Science Classroom

In this section, a critical review with respect to fostering creativity is provided with a focus on the science classroom. Five areas are discussed to a draw comprehensive review of the relevant body of literature: (1) discussing the relationship between creativity and the nature of science; (2) exploring possible and suggested approaches that foster students' creativity in the science classroom; (3) reviewing facilitating factors that support teaching for creativity; (4) reviewing constraining factors that hinder teaching for creativity; and (5) discussing relevant studies focused on science teachers' beliefs of and practice for fostering creativity.

4.3.1 Fostering creativity and the nature of science education

Researchers and scientists have all pointed to the significant role of creativity in science and the need to foster students' creativity in this domain (Shanahan & Nieswandt, 2009). Experts in the science domain acknowledge the importance of infusing creativity into science classroom activities and practices in order to enable students to build up their creative skills and perceive creativity as an integral aspect of scientific efforts. Hu and Adey (2002) indicated that fostering scientific creativity could be the purpose of fostering creativity in science classrooms or, as others assert, focusing on creativity in science classrooms could lead to development in fundamental creative thinking skills (e.g., Daud, Omar, Turiman, & Osman, 2012; McCormack & Yager, 1989).

Nevertheless, creativity is domain-dependant (Liu & Lin, 2014); thus, the development of creativity in the science classroom depends on the nature of the science education domain. In regard to the nature of science education, some educational authors have argued that a distinction exists between science and education, in which science education is situated. The distinction is based on how both domains (science and education) are valued by empirical facts or societal values; such a distinction could create drawbacks in valuing creativity in science education (Johnston, 2009; Osborne & Dillon, 2008). Johnston (2009) clarified that "science is commonly viewed as a body of empirical, non-political knowledge. Education is felt to reflect changes in society and views, is inherently political and values all knowledge and understanding and is therefore less static in its development than science" (p. 80).

Johnston (2009) argued that science education mediates two different natures, where nature is shaped by the stronger partner between science and education. Meanwhile, creativity is increasingly valued by subjective standpoints more than empirical facts (Osborne & Dillon, 2008). For illustration, if the nature of science is the dominant nature of science education and science curriculum is concerned with empirical and factual learning, then creativity in science education is valued by not only societal values, but also empirical facts. This situation could lead to the emergence of difficulties in valuing creativity in science education because science education is based on the dominant nature between the different natures of science and education.

Such an argument could be valid if the nature of science (NoS) is based only on factual norms. However, I would argue here that NoS is not limited to empirical facts. As numerous researchers have declared, creativity is embedded in the NoS. For example, Abd-Elkhalick and Lederman (2000) listed seven components, including creativeness and imagination, which shape the NoS. Meanwhile, creativity is a main constituent of the NoS according to the constructivist perspective (Akcay, 2013). The historical context of science has also accumulated numerous descriptions of creative innovation (Berson, 1999; Lambert, 2002; Sternberg, Kaufman, & Pretz, 2002) because science fashions thought through imaginative thinking governed by wisdom and judgement (Kind & Kind, 2007; Newton & Newton, 2010). Scientists assert that characteristics of creative persons and their works combine aspects of creativity; as Johnston (2009) emphasised, scientists are risk takers, and their work is creative, involving discoveries and relying on creative thinking skills.

Accordingly, if the NoS is not restricted to facts, then science education should not be inefficiently valued through facts either. For example, although diverse science curricula habitually highlight only the rational–empirical aspects of science (Shanahan & Nieswandt, 2009), many teachers perceive creativity to be an embedded constituent in science education (Park, 2011). Empirical evidence has demonstrated that science teachers believe that "science education provides immense opportunities for creativity as the nature of science is inherently creative" (Chander, 2012, p. 192). For example, Koulaidis and Ogborn (1989) found that chemistry teachers acknowledged the versatile nature of science; primary teachers held a similar perception by highlighting their awareness of the complicated nature of science education (Johnston, Ahtee, & Hayes, 1998). In addition, Johnston (2003, as cited in Johnston, 2009) investigated teachers' perspectives of science education with respect to their fitting into different philosophical stances (e.g., constructivist, positivist, traditionalist, and post-modernist). The results indicated that teachers had more creative perceptions of the subject and acknowledged its versatile nature. Some studies compared teachers' beliefs related to science education compared to other subjects. For example, Johnston and Ahtee (2006) compared 98 student teachers' attitudes on teaching science lessons and their attitudes on mathematics, physics, and English language using a semantic differential scale. The findings revealed that physics was viewed as a non-creative subject, although mathematics was the least creative one. Meanwhile, science education was viewed as a creative subject, albeit it was deemed to be less creative than English.

According to these studies, the nature of science education is seen as a complex nature and creative domain (Demir & Sahin, 2014); creativity also appeared to be a major component of NoS. Thus, creativity is assumed to be embraced in the science classroom; otherwise, science would be insufficiently delivered to students. As Shanahan and Nieswandt (2009) argued, when creativity is ignored and omitted in the science classroom, students are exposed to an inadequate view of what it means to be a person who engages in science-related activities. Thus, fostering creativity in the science classroom should be one of the prominent focuses in teachers' priorities by applying pedagogical approaches that serve this aim. The next subsection aims to review approaches to teaching for creativity that can be adopted in the science classroom.

4.3.2 Teaching for creativity in the science classroom

Pedagogical approaches for fostering creativity in the science classroom play a decisive role in recognising thoughts and viewing ideas from original angles. Kind and Kind (2007) reviewed diverse standpoints that define creativity in the science classroom and discussed diverse approaches that can be adopted by science teachers to foster creativity, such as poetry, imagery and imagination, practical work (investigative experiments), and inquiry-based science teaching. Other approaches have also been suggested in order to foster creativity in the science classroom, particularly in physics education. Cheng (2006) recommended different classroom practices to promote creativity in physics, such as inquiry, practical experiment, presentation, and the incorporation of science knowledge. Such practices could assist students in enhancing their imagination and their scientific thinking skills while connecting between them to come up with unusual ideas.

MacCormac (1976) highlighted the immense importance of these approaches in making extraordinary concepts more accessible. For example, one of the most broadly applied approaches to foster creativity in science classes is open inquiry (Johnson, 2000; Longo, 2010; Meador, 2003), which is considered to be a science process approach. New notions as well as creative thinking skills and attitudes can be developed when learners are engaged in open-ended inquiry and scientific research processes (Craft, 2000; Meador, 2003). Open inquiry processes, especially the process of generating hypotheses, create connections between existing understanding and new experiences (Starko, 2010). Open inquiry can also go beyond students' interpretation to identify their meta-cognitive process, including the mechanisms of problem solving and creative thinking (Shayer & Adey, 2002). A case in point, Haigh (2007) conducted a four-year study about students' engagement in open investigative practical work in science, particularly in biology, to explore how such engagement fosters individual and collaborative creativity. The research included three phases. Participants included 4 senior biology teachers and 5 of their Year 12 biology classes (phases 1 and 2) followed by 45 science teachers (phase 3). The findings indicated that an open investigative experiment is a suitable pedagogy for fostering students' creativity as well as possibility thinking. The study found that both teachers and their students demonstrated three kinds of creative endeavours in their participation: combinational (combining previous thoughts in novel manners), exploratory (being creative within the regulations of the field), and transformational (permitting changes to the regulations of the conceptual space).

In this respect, Haigh (2007) concluded that scientific thinking skills play a significant role in performing creatively during the investigative practical work, such as questioning skills. Therefore, teaching thinking skills can be another approach for fostering creativity in the science classroom, especially when developing scientific thinking skills (Shayer & Adey, 2002). Such skills can be improved through practical activities and the discussion of ideas that enable them to explicate their thoughts and think theoretically (Osborne, Erduran, Simon, & Monk, 2001). This would also enable them to draw connections between their imaginary thoughts and the investigated phenomenon (Johnston, 2009), leading to meaningful imaginative ideas. The review of the literature showed that several studies found that specific thinking skills are required to manifest creative outcomes (Cheng, 2010), yet most of these studies did not focus on the science classroom. Systematic thinking skills—or as Cropley (2001) called them, the skills of "getting ideas"—such as problem solving and brainstorming are good examples. Different studies have found that these sorts of thinking skills are based on sequential steps and aim to generate ideas and are significantly correlated with the production of creative ideas (e.g., Clow, De Nardin, Sani, & Stammefnohan, 2011; Gallagher, Sher, Stepien, & Workman, 1995; Gallagher, Stepien, & Rosenthal, 1992; Park & Seung, 2008).

Moreover, growing literature based on empirical evidence has found that possibility thinking is the core of the process of little C creativity; therefore, students' creativity is more likely to be fostered when their possibility thinking is encouraged (Craft, 2001). Possibility thinking was recently documented by a team of researchers in England seeking to validate a model of promoting possibility thinking in primary classrooms (i.e., Burnard et al., 2008; Chappell et al., 2008a, 2008b; Craft et al., 2012a, 2012b; Cremin et al., 2006). The findings of these studies revealed that the question-posing and question-responding process is the practical basis of possibility thinking. In other words, questioning skills would lead to new possibilities, as Haigh (2007) indicated, whose study found that students' possibility thinking is promoted when students try to answer a number of what, how, how many, when, where, and why questions. In Haigh's (2007) study, transcripts from both teachers and students showed a strong use of questioning skills by students in their engagement and after the practical work. Therefore, applying approaches based on questioning skills can foster students' creativity in the science classroom (Demir & Sahin, 2014; Meyer & Lederman, 2013).

Approaches based on cooperation and collaborative learning have also been recommended by creativity researchers. According to Felith (2000), pedagogical practices found to be positively efficient in fostering students' creativity included cooperative engagement and cluster groups. Mohamad (2006) applied grounded theory study using semi-structured interviews and classroom observations to explore teachers' beliefs about creativity and how to foster children's creativity in the classroom in Bruneian schools. The teachers believed that creating collaborative interactions, doing group work activities, and pursuing learning from playing offer effective learning opportunities to manifest creative performance. In the science classroom, for example, a recent study by Akcay (2013) used a group work approach. The students were divided into small groups to work on creating an imaginative insect model. Interactive engagement within each group was promoted by asking members of each group to apply the 5Es (engage, explore, explain, extend, and evaluate). The results indicated that groups were able to come up with imaginary insect prototypes.

However, one question that needs to be asked is whether certain factors contribute to designing and applying such pedagogical activities. Preparing and applying pedagogical practices to foster creativity could be influenced by social, psychological, and contextual aspects that guide science teachers to make decisions about how they develop the classroom activity. Thus, it is crucial to review the possible factors that might facilitate or even hinder the efficiency of pedagogical approaches for fostering creativity.

4.3.3 Facilitating factors of teaching for creativity

Fostering creativity in a specific context requires several adaptations to be an adequate context that welcomes creativity. Therefore, focusing merely on the pedagogical approaches is not enough; it must be combined with the accommodation of contextual factors that may or may not welcome students' creative endeavours. Such factors are discussed here with respect to the factors related to the teacher, classroom environment, and students.

The science teacher can be a facilitator and integrate creativity in the science classroom not only by applying creativity-fostering approaches, but also by ensuring the use of some supporting factors. For example, Sternberg (2006) asserted that teachers are required to pursue three stances to foster creativity in their classrooms. First, teachers should focus on students' thinking abilities and skills; for example, learners should be evaluated based on their participation in science experiences that are fluid, flexible, and multifaceted (Sternberg, 2006). Second, teachers should hold encouraging dispositions and affirmative sentiments towards being creative, as opportunities should be provided to learners to develop affirmative attitudes towards and feelings of creativity (Bereiter & Scardamalia, 2006; Sternberg & Williams, 1996). Finally, teachers should transfer the previous stances into action, fostering creativity by adopting classroom activities in which learners can creatively participate (Bereiter & Scardamalia, 2006). According to Sternberg's (2006) stances, holding positive beliefs about the self and its abilities plays very significant roles in students' participation in teachers' activities; such feelings can be enhanced through teachers' efforts during the classroom activities. The science teacher should come up with interesting and exciting classroom practices (Demir & Şahin, 2014) to attract students' curiosity and raise their willingness to participate creatively in classroom activities.

Another concern with fostering creativity in the science classroom is the supportive ecological practices. Teachers have to accommodate the classroom atmosphere to suit creativity conditions. Therefore, facilitating factors can be related to the classroom environment. For instance, Johnston (2007) examined students' skills of observation, recognising the significance of specific elements that help learners think creatively and solve problems. The study found that the classroom should be a stimulating context which provides sufficient time and space to support free engagement. In addition, Mohamad (2006) revealed that teachers believed that the best ways to foster students' creativity were to offer them enough time to complete the tasks, provide them with free space, offer materials for them to work with, and increase flexibility inside the classroom. These factors are more likely to be generated from an interactive environment, in which children interact with one another and develop their ideas or progressively change them (Shayer & Adey, 2002). An empirical illustration of the supportive practices is Felith's (2000) qualitative research with seven teachers, which used interviews and open-ended questionnaires to explore their pedagogical perspectives of how to foster students' creativity. The findings indicated that teachers believed that the context facilitates the development of learners' creativity when it supports flexible guidelines, free time for participation, confidence, and autonomy. Felith (2000) also found that the context should offer opportunities for learners to become aware of their creativity.

Other facilitating factors are associated with the students themselves. The students can be facilitators of teaching for creativity when they are personally prepared to interact creatively with the classroom practices. For instance, Zhou et al. (2013) discovered that being curious and interdependent are seen as facilitating features that students should hold to achieve that aim of teaching for creativity. Meanwhile, Aljughaiman and Mowrer-Reynolds (2005) stated that the most commonly provided answers regarding the features of creative students were thinking in a different way, being imaginative, being a risk taker, being artistic, and having a rich vocabulary. One of the most agreed-upon personal factors among researchers is being risk taker (e.g., Burnard et al., 2006; Dacey, 1989; Feist, 1998; Meyer & Lederman, 2013; Starko, 1995, 2001; Tardif & Sternberg, 1988; Taylor, 1995; Torrance, 2004), because reaching creative conclusions requires a degree of dealing with the unknown. Thus, being a risk taker and being tolerant to engage with mysterious activities that do not rely on providing direct responses would enhance the effectiveness of teaching for creativity approaches. Moreover, the students need to be aware of their creative potential, and it is important for students to have optimistic sentiments about themselves because self-perception can play a role in their participation in and interaction with classroom activities.

An empirical example is Shanahan and Nieswandt's (2009) study, which focused on three students who participated in three creative activities developed to teach learners about the Earth and space science. These activities aimed to offer an opportunity for participants to discover and articulate their ideas through imaginative and subjective approaches. They also aimed to demonstrate to students that creativity is a consistent element of science that may in turn develop their opinions of the practice and learning of science and their science identity. The first case demonstrated an extremely positive experience; the participant was consistent with her self-concept of being creative. She revealed that her success in meeting the science classroom expectations stemmed from her use of her creative skills in science. Similarly, the second case held a very optimistic reflection of the activities. The participant explained that, although he encountered some confusion in finding the expected answer in a regular science classroom, he found that the creative activities facilitated his exploration of expected answers and enabled him to reach them from various perspectives. The third case was different in that the participant held a low creative self-perception and strong science identity. Her interaction with the creative activities indicated poor and uncomfortable engagement; the only positive engagement occurred in one activity (lander design activity) because it was more coherent with her science identity. Interestingly, the first two participants achieved the classroom expectations and successfully completed their practices using their creative abilities; the successful outcomes of their endeavours were connected to their creative self-identity. Meanwhile, the third participant held a non-creative identity and struggled to use her imaginative and creative potential to complete the creative activities. The conclusion indicated that one question that needs to be asked is whether students' willingness to participate in teachers' activities that foster creativity could influence the outcome of such activities.

Generally, the need exists to identify facilitating factors especially for the science classroom. Most of the literature has provided general factors that apply for any subject, and only a few previous works have suggested specific factors. As Meyer and Lederman recently stated, the identified factors are "not specific to science classrooms, and an understanding of the pedagogy that encourages or impedes student creativity with respect to the science classroom is still needed" (2013, p. 400). Therefore, providing a list of facilitating factors for the science classroom would be more helpful for science educators as well as teachers. In addition to highlighting the facilitating factors, it is essential to review the constraining factors that would limit the emergence of creative endeavours in the science classroom.

4.3.4 Constraining factors of teaching for creativity

With respect to fostering students' creativity in the classroom, contextual (sociocultural) factors should not be ignored because they might play a role in teachers' pedagogical decisions related to the curriculum content, availability of resources, number of students, and school policies. Indeed, some studies have investigated not how teachers develop their classroom activities to foster students' creative skills, but rather the aspects that limit their efforts and decision making given that activities that foster creativity in science classrooms could face several difficulties and challenges, such as time, coverage of curriculum content, safety, and the acquisition of the learning objectives (Johnston, 2009). For instance, Fryers and Collings (1991) focused on teachers' constraints that negatively affect fostering creativity in the classroom. Their findings revealed that teachers suffered from a lack of resources; they felt that sufficient resources were not available for use in their classes. In addition, teachers indicated that large class sizes and inadequate time were problematic factors enabling them to foster creativity in their classes. The school's bureaucratic routines also kept them from their fundamental duties as teachers are often asked to do other things besides teach children. The study further revealed that parental expectations are somewhat of a constraint when parents demonstrate a high level of anxiety related to their children's performance. Mohamad (2006) concluded that negative factors such as pressure from parents, the school principal, and curriculum requirements contributed to primary teachers' non-creative approaches. Pedagogical limitations identified by the teachers included a large class and the lack of teaching assistants to help in the classroom, especially when there are students with special educational needs in the mainstream classrooms.

It can similarly be argued that the adopted practices could be affected by teachers' goal orientation, as evidenced in Hong, Hartzell, and Greene's (2009) study, which investigated the relations of teachers' epistemological beliefs and goal orientation to their pedagogical practices that foster student creativity. In their study, 178 primary school teachers participated and completed questionnaires. The findings indicated that pedagogical practices to foster students' creativity were significantly affected by the teachers' goal orientation. Thus, being a textbook-oriented teacher can strongly reinforce the direct transmission of textbook knowledge as a pedagogical stance instead of exploration, practical discoveries, and inquiry stances. In this case, the classroom activities are more likely to be based on the low quality of teaching and learning (Johnston, 2009), where the delivery of information from the textbook becomes the classroom priority. This sort of practice results from another difficulty—namely, the need to cover the curriculum textbook. Johnston (2009) argued that applying teacher-centred practice helps novice teachers to cover the curriculum areas. Another possible difficulty that discourages the use of more practical and scientific activities (e.g., discovery, exploration, and investigation) is managing the students' interactions inside classroom. Murphy, Beggs, & Russell (2005) found that teachers are willing to apply non-practical activities to control or reduce behavioural problems. Furthermore, Johnston (2009) pointed to the time difficulty, declaring that "effective and creative science education does take time for children to explore, investigate, and discover new ideas. It does involve giving children time and encouragement to support their explorations and discoveries and also support their behaviour" (p. 87). In Felith's (2000) study, the teachers highlighted the non-creative classroom with characteristics such as ignoring students' ideas, not accepting mistakes, and requiring only one right answer. Based on the analysis of the teachers' interview responses, some constraints hinder the development of students' creativity—namely, timed testing, structure and schedule, a huge curriculum to cover, and the lack of time. Meyer and Lederman (2013) also focused on the lack of resources as a constraint, as various lab tools and ICT are needed for generating new outcomes.

Furthermore, some studies have examined teachers' beliefs of creativity within different cultural contexts, such as Hong and Kang's (2010) study, which investigated science teachers' beliefs of creativity in school science. The results indicated that the contextual factors are perceived by science teachers to be constraints to teaching for creativity. The frequently declared constraints included the heaviness of content coverage for high-stakes examinations, obscurities in evaluating creativity, and class size. Another example was Zhou et al.'s (2013) study. The researchers distributed a survey to explore teachers' concepts of creativity; 515 teachers from 3 countries (i.e., Germany, China, and Japan) completed the questionnaire. Zhou et al. (2013) found that a lack of resources, teachers' discipline, a heavy workload, and assessment systems are elements preventing the fostering of creativity. In addition, these factors differ from one context to another in terms of their influences on the teachers of each context.

Similarly to the facilitating factors, most of these constraints were explored in general classrooms (Meyer & Lederman, 2013). The current study aims to list these sociocultural factors and identify their influences when they mediate teachers' beliefs and practices.

4.3.5 Science teachers' beliefs of and practice for fostering creativity

Some studies have revealed that teachers have a tendency to consider constructing something original as being creative; they also appear to connect creativity with the arts (e.g., Diakidoy & Kanari, 1999; Edmonds, 2004; Fryer & Collings, 1991; Kampylis, 2010; Mohammed, 2006). Other teachers define creativity and acknowledge its importance in their taught subjects, but it is not one of their pedagogical concerns (Aljughaiman & Mowrer-Reynolds, 2005; Cropley, 2001; Newton & Newton, 2010; Schacter, Thum, & Zifkin, 2006). However, all fields of the school curriculum can embrace creativity, and it is a misconception to believe that the province of the arts is the only rightful area in which to demonstrate creativity (Faultley & Savage, 2007). For example, one science teacher said that "creativity always goes hand-in-hand with art, drama, dance, music, [but] it isn't just about the arts, so to speak, it's about being creative with the curriculum" (Faultley, 2005, p. 12). In the context of the science classroom, few studies have investigated science teachers' beliefs about how to foster creativity. Previous empirical works have recognised the absence of studies that specifically report science teachers' beliefs about creativity in the science classroom (Liu & Lin, 2014). Hence, further critical review of relevant studies is offered here.

The literature contains studies that seek to determine how science teachers perceive the nature of science education as well as creativity. Despite the fact that such studies have contributed to developing arguments for integrating creativity into science education, several issues regarding how to integrate and the requirements for fostering creativity in the science classroom were either absent or poorly identified. For example, Taylor, Jones, Broadwell, & Oppewal (2008) compared the beliefs of 21 intermediate and secondary science teachers with the beliefs of 37 scientists from different scientific fields. The researchers were interested in exploring participants' beliefs about science education in regard to three concepts: quality, creativity, and accountability. The scientists declared that science education suffers from poor teaching and learning provisions; they maintained the need to develop the quality, which necessitated science teachers gaining more experiences with conducting inquires, and using multiple resources as well as developing thinking skills. According to the scientists, science should be an exciting and interesting subject for students. Indeed, 76% of science teachers agreed that thinking skills (e.g., creative and critical skills) need to be taught; the teachers also acknowledged the importance of inspiring students' creativity in science to help them perform creatively in their classes. Taylor et al. (2008) generally highlighted similar results about teachers' beliefs on the nature of science education to the findings of other studies (e.g., Johnston & Ahtee, 2006; Johnston et al., 1998; Koulaidis & Ogborn, 1989). These studies concluded that science teachers are more likely to perceive the nature of science education to be complex and not static, where creativity can be fostered because creativity is part of constructing scientific knowledge (Meyer & Lederman, 2013).

Other studies have pursued science teachers' beliefs about creativity and acknowledged the role of cultural background in constructing teachers' beliefs; nevertheless, the cultural forces were not evident in their empirical work. As a result, questions remain regarding the sociocultural role science teachers' beliefs and practices play. For example, Park et al. (2006) studied South Korean science teachers' insights into creativity and science schooling during a programme concerned with creativity. The researchers concluded that participants believed that all students can demonstrate creative endeavours, creativity can be nurtured in science, and science possesses numerous activities that support creativity. Perceiving creativity mirrors cultural principles. Cultural backgrounds can influence individuals' beliefs of creativity and their capability to illustrate it (Craft, 2003; Csikszentmihalyi, 1999; Hong & Kang, 2009; Lubart, 1999). In other words, what would be considered as creative in one civilised background might be considered as non-creative in a dissimilar background.

More specifically, the principle of Hong and Kang's (2009) study was to examine secondary science teachers' formations of creativity in science and teaching for creativity in the science classroom. Considering the cultural and contextual reliance of teachers' beliefs, this study also examined possible cultural and background differences in teachers' beliefs of creativity by comparing those of secondary science teachers from South Korea and the United States. They found that each individual teacher's beliefs were significantly restricted, but the teachers' beliefs of creativity as a whole group were consistent with the literature. In terms of teaching techniques for creativity, the teachers generally emphasised problem- or project-based inquiry, which was also consistent with the literature. The South Korean teachers tended to consider morals as a more significant decisive factor for judging creativity than the American teachers and emphasised the need to provide thinking opportunities to foster creativity, whereas American teachers emphasised ecological or emotional support. However, the researchers offered no explanation for the distinction between American teachers' beliefs and South Korean teachers' beliefs. This could be a result of the content of the distributed questionnaire, which was limited by questions about beliefs about creativity and how to foster it in science classrooms while ignoring that participants came from different cultural and historical backgrounds. Had the questionnaire included sections that focused on the cultural and historical aspects forming teachers' beliefs, it could have offered a more in-depth distinction between the two groups of participants.

Other studies have found naive or insufficient beliefs about creativity in the science classroom (e.g., Lee & Kim, 2005; Newton, 2010; Newton & Newton, 2009, 2010). Lee and Kim's (2005) study aimed to investigate the beliefs of creativity among Korean science teachers of gifted students. Sixty teachers participated in this research, completing an open-ended questionnaire about their beliefs of creativity. The results demonstrated that these science teachers had a comprehensive belief of the cognitive constituent and a well-built connection of creativity with intellectual aptitude, but celebrated the cognitive component, showing less awareness of the individual and ecological mechanisms of creativity. Such findings might stem from how the questions were posed. Lee and Kim (2005) focused only on science teachers' beliefs about creativity and overlooked the role of teachers and schools in fostering creativity. If teachers believe that creativity is only a matter of cognitive abilities, then they might believe that teachers and schools should not foster creativity because it is only a matter of a cognitive model that does not interact with other social forces. As such, the authors limited their investigation in asking teachers only about how they perceive creativity.

Furthermore, Newton and Newton (2009b) conducted a study to identify some primary school student teachers' beliefs of creativity in school science lessons. Participants' understanding was limited, focusing primarily on sensible explorations of matters of fact and integrated misconceptions. The researchers advised teacher trainers that student teachers' ideas of creativity can be insufficient in numerous ways, and they might exclude significant opportunities for involving creativity, such as the imaginative processing of scientific information and the building and examination of justifications. As perceptions can be fashioned by creativity in the arts, it is recommended that science instructors facilitate the connection by introducing students to the broader term of productive thought (i.e., a mixture of creativity and critical thought that is predominantly appropriate in science). The following year, Newton and Newton (2010) found that teachers frequently advocated for fostering creativity, but their notions of creativity in particular school subjects might have limitations that lessened their endeavours to do so. Newton and Newton asked primary school teachers in England to rate lesson activities according to the opportunity they presented pupils for creative reflection in science. The teachers could, overall, differentiate between creative and reproductive tasks, but the findings confirmed a contracted understanding of creativity, prejudiced towards fact-driven results, practical actions, and technological designs. A number of teachers viewed creativity as essentially reproductive activities as well as merely enthused interest in on-task talk. In the same academic year, one of the two authors investigated pre-service and trainee science teachers' concepts of the assessments of creativity in science. Newton (2010) asked 12 pre-service science teachers to assess explanations of selected science events. The findings showed that the overall assessment of creativity differs among informants, but the agreement was more evident within some aspects of creativity. Overall, the informants' beliefs of how to judge scientific events appeared to be naive.

Contrary to the empirical findings of Newton and Newton (2009b, 2010) and Newton (2010), Liu and Lin’s (2014) more recent study conducted in Taiwanese context found that science teachers appeared to hold somewhat progressive beliefs about creativity. This finding can be attributed to the target participants. For example, the former researchers’ sample included pre-service teachers whereas the latter researchers’ sample included experienced science teachers with an average of 22 years of teaching (ranging from 8 to 41 years). More experience in a particular subject can arguably lead to growth in the teachers’ beliefs of creativity (Newton & Newton, 2009a). In Liu and Lin’s (2014) study, 16 science teachers from Taiwan (8 male and 8 female) participated to reveal their beliefs about creativity in the science classroom. The aim of the study was to explore the teachers’ beliefs in terms of the meaning of scientific creativity, aspects of creative students in the science classroom, and the science classroom aspects that could develop scientific creativity. The data were collected through a mix of qualitative methods, such as open-ended questionnaires and follow-up interviews. The results revealed that pedagogical approaches for creativity encourage autonomous learning, such as hands-on activities (practical) and inquiry-based learning. Meanwhile, creative students in science should be curious, interested, and observant. Furthermore, the teachers were able to mention the central aspects related to creativity as well as those fostering creativity; however, they missed some other important aspects, such as convergent thinking and problem-solving skills.

Liu and Lin (2014) acknowledged that their study did not offer data with respect to the classroom practices; thus, their suggestion was to investigate beliefs and practices to come up with a better understanding about fostering creativity in the science classroom. Even Meyer and Lederman (2013), who observed classroom practices, did not highlight clear findings about teachers’ practices. Meyer and Lederman (2013) collected data from 17 science teachers from different educational levels and contexts (intermediate level, secondary level, college level) using a questionnaire, interviews, and observations. The study aimed to determine the components of creativity-welcoming environments that develop students’ creative thinking. The study revealed five categories: flexibility versus ambiguity, clear behavioural expectations, social interactions, questioning, and openness to alternatives. These categories were identified as pedagogical characteristics. My concern is that these categories are pedagogy-related components for fostering creativity, but it is difficult to claim that these are components of supportive environments. Frankly, findings about the surrounding contexts were absent. The study collected data from different contexts (intermediate level, secondary level, and college level), but the findings did not differentiate the findings according to these contexts. In addition, examples of the observed practices and their relationship with the teachers' practices were omitted.

The reviewed studies thus far suffer from the fact that teachers' beliefs were explored without exploring their practices, which in turn provides only a partial picture of the science teachers' understanding of fostering creativity. Accordingly, addressing science teachers' beliefs about creativity and observing their practices could lead to a better understanding of belief–practice relationships as well as the role of sociocultural contexts in which science teachers interact.

4.4 Reflections on the Chapter

The review of literature on science teachers' beliefs and practices regarding fostering creativity has indicated some significant issues and limitations, which the current research aims to address. One of these significant points is teachers' beliefs. The reviewed studies of science teachers' beliefs did not illustrate the complex nature of beliefs and how they interact with sociocultural sources. According to the sociocultural literature, beliefs are cultural tools or artefacts; more specifically, they are psychological signs that mediate socially mediated activities. Thus, they are embedded in the sociocultural sphere. This sphere must be explored.

For example, some studies sought to identify pre-service science teachers' beliefs whereas others examined teachers' beliefs based on their prejudged knowledge of creativity. The earlier studies did not investigate teachers' beliefs and practices together. These limitations could be a result of disregarding the sociocultural context of the researched environments. Exploring beliefs and practices in one investigation might call for an exploration of context in which these beliefs and practices are embedded because the contextual influences can justify the consistencies or inconsistencies between their beliefs and practices. Such a contextual investigation is more likely to require qualitative data collections and methods, yet most of the reviewed studies adopted primarily surveys or questionnaires with close-ended, open-ended, or incident statements to measure science teachers' beliefs. Thus, the present research will utilise multiple qualitative methods to collect rich data and offer more spacious opportunity for participants to freely reveal their beliefs, justify their actual practices, expose their concerns, and express their perspectives.

In addition, some existing studies have designed possible activities to be applied by science teachers that do not represent these teachers' actual applied pedagogical activities. As long as the teacher is responsible for making decisions about what should or should not be applied as well as what activities foster students' imaginative and creative efforts, research should focus on the science teachers' beliefs and practices in real settings. It is important to explore what science teachers believe about pedagogies that foster their students' creativity and to what extent such beliefs are connected to the contextual elements around the teacher. It is also critical to observe classroom practices in the actual context, without creating a modified environment to understand the science teachers' activities. These issues are in line with the focus of the current study.

Finally, this chapter has highlighted the author's personal reflections on the creativity research that explored science teachers' beliefs and practices. It also highlighted the most significant conclusions related to the focus area and its recommendations. The conclusions of the reviewed studies have emphasised the need to pursue more in-depth studies of creativity in science classrooms. The current study considered the further suggestions of the existing research body to fill existing gaps, develop research questions, and make relevant methodological decisions. The literature suggestions have served as the basis for forming the most convenient framework to approach Kuwaiti science teachers' beliefs and practices and the sociocultural context in which they interact.

Chapter Five: Research Methodology

5.1 Introduction

Educational studies commonly investigate various phenomena using different methods, strategies, and analyses. These different methodological applications could inform us about the nature of the research, the researcher's position, and ethical considerations. They can also be viewed as a mirror that reflects the underlying philosophical assumptions or paradigm of the research. From this brief introductory paragraph, it can be exemplified that research methodology is constructed from a number of research elements or components to enable researchers to attain specific answers and accomplish particular aims. Therefore, this chapter explains the research methodology used in the current study by enlightening these constitutional elements.

This chapter is divided into several sections. First, the chapter aims to discuss research paradigms in general and to justify the interpretive paradigm adopted in the current study. The research paradigm is an imperative subject because it is the basis of the researchers' role, decisions, plans, applications, and findings. Second, the research design is discussed by explaining the multiple case studies design. This is followed by a third discussion with respect to the cases' selection. The fourth methodological element is concerned with data collection. Various methods, such as semi-structured interviews, focus groups, observations, participant drawings, and field notes, were developed and justified by evaluating their strengths, drawbacks, and possible practices to delimit such drawbacks. Practical procedures for collecting the data are subsequently highlighted. The chapter then highlights the analytic techniques adopted in order to deal with raw data and illustrate the findings. Other elements are also addressed, including ethical considerations and research trustworthiness. The discussion of the ethical considerations highlights the researcher's awareness of some ethical and moral principles that must be considered; meanwhile, the study's trustworthiness is also explored by discussing the validity and reliability issues of qualitative research.

This chapter commences by introducing the research questions used to justify the methodological decisions of the current study, which are reiterated as follows:

Primary research question: What are teachers' beliefs and practices regarding pedagogical approaches to fostering everyday creativity in science classes in Kuwaiti intermediate schools?

Sub-research questions:

Q1: What beliefs do science teachers hold about pedagogical approaches that foster creativity in the science classroom?

Q2: What are the sociocultural factors that facilitate these pedagogical approaches?

Q3: What are the pedagogical classroom practices of science teachers in Kuwaiti intermediate schools?

Q4: How do science teachers perceive the sociocultural factors that mediate their pedagogical beliefs and practices to foster creativity?

Q5: How consistent are science teacher's practices with their beliefs?

5.2 Research Paradigm

The adoption of an appropriate paradigm is a key issue for every research because it allows the researcher to make sense of the world. According to Guba and Lincoln (1994), paradigm can be perceived as a worldview or philosophical faith that guides the investigators in studying various issues in the educational field. It represents the researcher's vision of the world, interpretations of what is viewed, and recognition of where reality is embedded and how it should be documented (Ernest, 1994; Mertens, 2010; Rubin & Rubin, 2005). Paradigms are built through philosophical assumptions and questions that direct the researcher's planning and decisions. These fundamental assumptions are related to ontology, epistemology, and methodology. These assumptions are the foundation of any research study and its approach to operation. Thus, researchers should question these assumptions when developing research foundations. According to Guba (1990), these questions are formulated as follows: (1) Ontological: What is the nature of the "knowable"? Alternatively, what is the nature of "reality"? (2) Epistemological: What is the nature of the relationship between the knower (the inquirer) and the known (or knowable)? (3) Methodological: How should the inquirer go about finding knowledge?

Three areas are discussed in this section. The first area aims to introduce the fundamental philosophical principles of the major paradigms in social sciences. The second area aims to discuss the interpretive paradigm, which is adopted in the current study, based on its assumptions. Finally, the third area aims to discuss and justify the appropriateness of sociocultural framework for the current study.

5.2.1 Major Research Paradigms

According to theorists, three major paradigms are adopted in the social sciences: positivist, transformative or critical, and interpretive paradigms (Clark & Cresswell, 2008; Cohen, Manion, & Morrison, 2007; Guba & Lincoln, 1994, 2005; Lather, 1992; Mertens, 2010). Different labels can represent these paradigms; thus, it is worth summarizing and describing the common labels and philosophical assumptions of these paradigms as used by theorists. One question emerges regarding such a comparison among these paradigms: How are these paradigms related to the current study? The aim of this brief summary is not to discuss the paradigms, but rather to distinguish between the adopted paradigm (interpretive) and other major ones.

Since the early 19^{th} century, a large number of researchers have believed in the positivist worldview, which assumes ontological realism. Positivists believe in the existence of only one reality derived from natural science (Ernest, 1994), as they claim that no differences exist between natural and social sciences. Positivism takes for granted that one reality exists autonomously of people's knowledge (Guba, 1990) with no place for the subjective role to interact with reality. Such belief supports objectivity as the epistemological assumption to achieve the required knowledge. Objectivity is considered within the positivist paradigm to be overruling and is alleged to be attained by observing subjects from a fairly distant and unemotional standpoint (Clark & Croswell, 2008). According to this standard, researchers should not allow their personal biases to influence the outcomes in research; the researcher should remain neutral to prevent values or biases from influencing the work by rigorously following prescribed procedures (Mertens, 2010).

However, such assumptions have been criticized by number of social science researchers, who assert that differences exist between the nature of objects and the nature of humans. Such criticism has led to some philosophical modifications of the positivist assumptions that generated the post-positivist paradigm. Post-positivist researchers believe in critical realism rather than realism as an ontological assumption and in modified objectivity rather than objectivity. Critical realism advocates that the actual world is determined by real natural causes; however, it is extremely difficult to accurately understand this due to the deficiency of humans' sensory and intellective systems (Cooks & Campbell, 1979, cited in Guba, 1990). Modified objectivity asserts that it is extremely difficult to maintain comprehensive objectivity; therefore, the epistemology is more likely to be modified objectively, as Reichardt and Rallis (1994) distinguished that knowledge of presumptions, propositions, and surroundings can powerfully manipulate what is being observed. Both positivist and post-positivist researchers adopt mainly quantitative, interventionist, and de-contextualized methodology to study social phenomena. The advocates of such paradigms usually apply experimental, quasi-experimental, correlational, causal-comparative, and randomized control trial approaches.

The second major paradigm is the transformative worldview, which supports minorities and empowers people. The assumptions of this paradigm criticize and reject the positivist worldview about reality and knowledge. The aim of this paradigm is usually to bring about change and empowerment (Cohen et al., 2007). Thus, researchers following this paradigm are concerned with ensuring justice and improving people's lives, which in turn leads to a focus on finding the truth from people who are in some way stereotyped, such as those with disabilities, gender differences, and minorities. According to Mertens (2010), the ontological position rejects cultural relativism and acknowledges that diverse editions of truth are based on social positioning. Researchers who follow this paradigm cannot investigate the truth without engagement with participants. An interactive connection between the investigator and participants is based on trust, and knowledge is situated in social and historical spheres (Mertens, 2010). Although this paradigm tends to foreground the lived experiences of people and adopt qualitative methods, it is not limited to only qualitative methods; it can also embrace quantitative and mixed method strategies to investigate, collect, and analyse data. Hence, researchers in the transformative/critical paradigm tend to select the most appropriate and relevant techniques for the investigated social phenomenon.

5.2.2 Interpretive Paradigm

The interpretive worldview believes in multiple realities instead of one reality, where reality is seen as a production of social construction based on humans' interactions. This paradigm is adopted because it has explanatory nature in which it can explicate the experiences of individuals within the researched context, as suggested by Radnor (2001). It enables the researcher to find out how individuals as social actors perceive the social world. Here, I shall discuss the underlying assumptions of the interpretive paradigm in relation to the current research.

5.2.2.1 Ontological assumption

According to Ernest (1994, p. 20), ontology is "a theory of existence concerning the status of the world and what populates it". Crotty (1998, p.10) defined ontology as "the study of being concerned with the nature of existence and its structure". In social sciences, Bryman (2004) declared that an ontological assumption is an issue of "whether the social world is regarded as something external to social actors or as something that people are in the process of fashioning" (p. 3). Constructivist researchers believe that there is no one reality or single truth; the ontological assumption of such paradigm advocates for the existence of multiple realities constructed by people. According to Guba (1990) and Mertens (2010), social constructivists believe that various realities exist as a production of manifold mental constructions of the social actors. These realities can be found in human minds, and they are generated from the interaction between their cognitive process and social context and culture in which they live (Cohen et al., 2007). More specifically, social reality emerges from manifold and varied interactions of persons (Sawyer, 2005). The constructivist tradition is based on the recognition of the complex nature of social aspects comprising the context under the investigation.

A case in point is that these realities are created through an inter-subjective nature and do not exist independently; hence, limitations can emerge when researchers, such as positivists and post-positivists, aim to diminish these realities via quantifiable numbers and objective knowledge (Crotty, 2003). Yet, this inter-subjective reality is the key aim of inquiry and in its nature; uncomplicated rules or deterministic relations cannot represent it (Hammersley, 1992). Knowledge should be generated and reality should be understood with respect to the interpretation of accounts of individuals' lived experiences because the extent to which complex statistics is adopted in order to disclose patterns of metaphysical world is less significant (Kirk & Miller, 1986).

With regard to the current research, ontology exemplifies the constructivist reality known as 'social constructivism' in a number of ways. The study alludes to social constructivism by asserting that the methodology is grounded in an understanding of reality as socially constructed according to how individuals are positioned in the world (Chappell & Craft, 2009). Practically speaking, this position can be maintained when the research procedures allow for the themes constructed by negotiating meanings to emerge from a study: "The meaning of what they do or say depends on the existence of others who will interpret correctly what is said and done" (Pring, 2004, p. 104). These mental constructions or multiple realities could be different or conflicting in terms of the individuals' differences of their lived experiences and the social influences.

5.2.2.2 Epistemological assumption

Epistemology is a term allied with the nature of knowledge. Crotty (1998, p.3) explained that epistemology is "a way of understanding and explaining how we know what we know". More specifically, epistemology in social sciences refers to whether or not a natural science model of the research process is appropriate for studying humanity (Bryman, 2004).

Some authors have claimed that the ontological plane indicates the epistemological assumption (e.g., Crotty, 1998; Grix, 2004; Scott, 2007). In this case, the epistemological position can be recognized when two issues are clarified: the relationship between the researcher and the investigative context and the researcher's mode of acquiring knowledge. Regarding the first issue, the relationship between the researcher and the participants is more likely to be interlaced. Interpretive researchers not only create the methodological activities and techniques, but also interact with the investigated context. Such relationship is not value free; rather, it has shared values in which knowledge is conciliated and negotiated by participants and the researcher. The second issue is associated with how knowledge is obtained or how theory and practice are formed. This issue is quite significant because

> educational research has always aspired to be a "practical science": "practical" in the sense that it seeks to generate rational knowledge that will have a significant and worthwhile effect on the decisions and judgments of educational policymakers and practitioners; a "science" in the sense that it seeks to generate this knowledge in accordance with prevailing standards of rigour, rationality and truth (Carr, 2007, p. 271).

For instance, positivists use a deductive approach by applying logical procedures to deduct a theory; they then examine and confirm this hypothesized theory through practices. Meanwhile, the interpretive paradigm adopts the opposite belief, that is, reality is socially constructed by people as an ontological base. Accordingly, the epistemological principle then states that knowledge should be inductively attained by observing the context and its multiple practices to generate a theory related to what is happening in the researched context. As a result, these two issues that justify knowledge characterize the epistemological position as inter-subjectivism. According to Mertens (2010, p. 19), this epistemology applies when “the inquirer and the inquired-into are interlocked in an interactive process; each influences the other. The constructivist, therefore, opts for a more personal, interactive mode of data collection”.

5.2.2.3 Methodological assumption

Methodology is “a theory of which methods and techniques are appropriate and valid to use to generate and justify knowledge” (Ernest, 1994, p. 21). Welllington (2000) explained that methodology also intends to describe, evaluate, and justify the applied methods, which Ernest (1994) defined as a theory about which techniques to employ.

In this respect, constructivists are more likely to apply inductive approach of data collection (Mertens, 2010). The inductive mode for reaching acceptable knowledge does not require people to confirm predetermined answers. Rather, it seeks to understand particular social phenomena from individuals’ perspectives (Bryman, 2004). This mode forms the basis of the methodological assumption of the interpretive paradigm (Kaplan & Maxwell, 1994) in which research tools should be flexible and facilitate the emergence of people’s perceptions of the studied social situation. Thus, the current research is qualitative in nature. It allows the researcher to pursue the people’s perceptions related to the context and allows participants to reflect on their experiences about the researched phenomenon freely.

5.2.3 The appropriateness of sociocultural framework for the study

The literature review of creativity as well as teachers’ beliefs and practices has shown the importance of sociocultural variables in shaping and forming these concepts. Meanwhile, the study is interested in exploring science teachers’ beliefs and practices in relation to their surrounding sociocultural sources given the idea that what the teachers hold or do is constructed through interactive development between the science teacher and related sociocultural variables. The sociocultural perspective reflects a constructivist view that explains human development not only from individualism or from socialism points of view, but also from the mediation that occurs between them. Humans’ interactions with their contextual, cultural, external, and personal events can be viewed as the cases of personal knowledge construction. Therefore, the ontological assumption of the current research is that reality is socially constructed.

In other words, the sociocultural perspective believes that knowledge structure and human development stand on the interdependence between social and individual processes through symbolic or physical tools. The Vygotskian perspective argued that humans do not perform straightforwardly in the physical world; instead, they change the world and the related conditions of their lives based on developing cultural tools and labour activities. This perspective highlights the importance of cultures, social engagement, and individuals' processes in understanding human activity through the interdependence among them. The research questions of the current study aim to investigate the beliefs and practices of science teachers based on these interdependent processes. Such research questions have a sociocultural nature based on interdependence among the personal, social, and cultural elements, as explained by advocates of the sociocultural perspective.

For example, personal development, including higher functional abilities, is affected by social sources (Wertsch, 1991); however, the influence is not continuous in nature. This means that human development is located in, yet not restricted by, social sources. A case in point is that Vygotsky (1978) stated that the dependence on caregivers is the starting point of human development, which is based on transmitting others' experiences. He developed the genetic law of development, arguing that any mental function emerges at two sequential levels. The first appearance emerges at the social level where it occurs between subjects as an inter-psychological category. The second occurs as intra-psychological category in which an individual acts without the need for social engagement. Thus, Vygotsky stated "all higher psychological functions are internalized relationships of the social kind and constitute the social structure of personality" (Valsiner, 1987, p. 67).

In other words, social interaction generates the primary experiences for individuals, followed by role translation in which individuals embrace a self-learning position and participate in interactive activities (Lantolf, 2000; Lave & Wenger, 1991). With respect to internalization, Lantolf (2000) asserted that the junction between culturally mediated signs and individual thinking takes place in the reconstruction of socially mediated forms of activity at the inner psychological level. Vygotsky (1978) exemplified that the process of internalization comprises a sequence of transformations:

> 1) An operation that initially represents an external activity is reconstructed and begins to occur internally …; 2) an interpersonal process is transformed into an intrapersonal one …;3) the transformation from interpersonal process to

> intrapersonal one is the result of a long series of developmental events. (pp. 56–57)

Therefore, personal development, including personal knowledge, beliefs, thinking skills, and other cognitive skills, is transformed and internalized from socially mediated forms of activity in which the individual interacts. In return, research questions investigate the pedagogical beliefs of science teachers that are internalized forms as well as the sociocultural contexts of these beliefs that are the external social forms of interaction. Moreover, the pedagogical practices are also explored as a social form of interaction.

This raises a question about how the social surface and individual surface, as forms of mediated activity, are integrated. Accordingly, this study highlights the meanings of culturally artificial tools and the mediation process between the two surfaces. The sociocultural perspective has no direct interaction between individual and physical or social contexts without culturally mediated artefacts or tools (Wertsch & Stone, 1985). These artefacts are the creation of cultural developments transferred from the former generation to the latter generation; the latter generation not only receives the tools, but also reconstructs them to fit cultural needs and construct knowledge (Lantolf, 2000). In addition, the integrated cycle allows the transformation process from the external form to the internal form, leading to personal development. Thus, semiotic mediations are not only indispensable factors for comprehending the development of higher mental processes, but they are also the meeting point that links social and historical processes as well as individual and mental processes by internalizing meditated forms offered by cultural, historical, and social influences within the individual's mind (Wertsch, 1994, 2007).

Wertsch was interested in understanding the mediation process underlying the sociocultural perspective. Thus, he incorporated Vygotsky's texts and research to understand Vygotsky's philosophy, especially the use of signs and tools in the meditational process, concluding that

> [Mediation] is the key in his approach to understanding how human mental functioning is tied to cultural, institutional, and historical settings since these settings shape and provide the cultural tools that are mastered by individual to form this functioning. In this approach, the meditational means are what might be termed the "carriers" of sociocultural patterns and knowledge (Wertsch, 1994, p. 204).

Nevertheless, Wertsch (2007) noted that researchers and theorists have interpreted "mediation" differently according to different examples and research findings from

Vygotsky's writings. As a result, Wertsch (2007) categorized mediation into two major themes, explicit mediation and implicit mediation, based on Vygotsky's works. In explicit mediation, two senses are viewed as explicit: (1) "it is explicit in that an individual, or another person who is directing this individual, overtly and intentionally introduce a 'stimulus' into an going steam of activity" (p. 180); and (2) it is explicit in the sense the stimulus means or the use of tools appears to be observable and obvious. In this case, the tools are already designed and assigned by peripheral force, such as the teacher's reorganization of an activity for his/her students. Meanwhile, the implicit mediation, according to Wertsch (2007), is less obvious and more difficult to observe. This sort of mediation consists of signs, as natural language, which have developed through communication, and they are used in different activities. The signs are further integrated with mental functioning, such as remembering and thinking, leading to a hardship of viewing them as objects of consciousness or reflection.

5.3 Research Design (Multiple Case Studies)

The current study is interpretive in nature, asserting the existence of multiple realities that are the production of constructed knowledge of humankind. Therefore, the methodological approach needs to be rigorous with the ontological and epistemological assumptions. This section aims to highlight and justify the methodological approach of the current study. It also aims to discuss the significance of the adopted design in answering the research questions. In addition, it includes a discussion of the nature of the design and its processes.

Regarding the significance of the case study design for the research questions, several justifications can be explicitly illustrated. Throughout the development of the theoretical framework of the study, the researcher found that the case study approach was superior to other designs for several reasons. For example, Phipps (2009) reviewed the existing literature of case studies and identified five major features of the case study approach: particularity, complexity, contextualization, multiplicity, and flexibility. These features are imperiously required in the current study as part of the methodological decisions.

- *Particularity:* Case study approach is a process of building up concentrated and detailed knowledge with respect to a particular case or several associated cases (Robson, 2002; Stake, 2005). Such elaborate knowledge can lead to rich data of a particular situation and its circumstances. It also helps the researcher gain a more comprehensive understanding of the researched situation, and it essential for addressing the identified gaps in previous research, where findings have been limited to participants' beliefs.

- *Complexity:* Case study approach "provides rich, in-depth insights and holistic understanding of complex phenomena" (Phipps, 2009, p. 37). The literature review acknowledged the intricacy of teachers' beliefs and practices that have contextual and cultural roots (see Chapter 4). In addition, the literature on creativity acknowledged that creativity is a complex phenomenon (see Chapter 3), where multiple theories, definitions, and approaches exist. Thus, pursuing multifaceted and complex concepts, such as beliefs, practices, and creativity, requires a research design that handles such intricacies.

- *Contextualization:* Case study approach can explore the contextual and sociocultural variables in relation to teachers' beliefs and practices. As Yin affirmed, "you would use the case study method because you deliberately wanted to cover contextual conditions—believing that they might be highly pertinent to your phenomenon of study" (2003, p. 13). Yin's statement suggests that case study designs should be applied if the contextual sources surrounding the researched phenomenon are significant and interdependent with it. Meanwhile, the sociocultural variables related to science teachers' beliefs and practices are a key area of focus in the current study. Therefore, the multiple case studies approach can provide the research with deep and rich data with respect to the sociocultural elements.

- *Multiplicity:* The case study design can include multiple methods to empower the researcher to collect an intensive amount of data about the researched context. Cresswell (2007) stated that this approach has a qualitative nature that facilitates the investigation of "a bounded system (a case) or multiple bounded systems (cases) over time through detailed, in-depth data collecting involving multiple sources of information (e.g., observations, interviews, audiovisual material, and documents and reports)" (p. 73). Furthermore, Bryman (2004) argued that applying multiple methods is an inclusive and detailed strategy that enables researchers to investigate the problem from various perspectives, making it practically valuable.

- *Flexibility*: Case study approach has a flexible design, which can cope with emergent coincidences and difficulties during the data collection (Anderson & Arsenault, 1998; Phipps, 2009). It could identify teachers' beliefs and practices from dissimilar manners, allowing teachers to illustrate their beliefs and practices through flexible forms of data collection and practical procedures.

These five features reinforced and informed the choice to adopt multiple case studies in the current research. It is true that some of these features are not limited to a case study but are utilized in other research designs. However, case study collectively embraces the five features as a unified set.

With respect to the type of design, case study approach can serve different methodological purposes. Frankly, the literature of case study designs accumulated different types to serve different purposes. Here the discussion refers to the most common types and then describes the one adopted in the current research. According to Yin (2009), case studies can be descriptive, exploratory, and explanatory. For example, a descriptive case study focuses on generating comprehensive descriptions about a specific phenomenon by studying a prototypical case. Meanwhile, an exploratory case study aims to explore particular phenomenon within real contexts, including the relationships among contextual variables. The explanatory case study aims to examine the causality of the researched phenomenon based on detailed data. Meanwhile, Stake (1995) identified three types of case studies: intrinsic, instrumental, and collective case studies. A researcher who has a genuine curiosity about a particular case can utilize an intrinsic case study, which is generally not used for building up theories (Baxter & Jack, 2008; Stake, 1995; Zainal, 2007). An instrumental case study can be conducted when it aims to achieve something, such as building up or refining theory; it can explore specific patterns of behaviours among a small number of individuals (Baxter & Jack, 2008; Zainal, 2007). The collective case study design is based on replication when more than one case study is undertaken. Yin (1994, 2003, & 2009) called this multiple case study design. The power of multiple case study design is that it can be used for generalization purposes and for developing theories (Baxter & Jack, 2008; Stake, 1995; Yin, 1994, 2003, 2009; Zainal, 2007).

The current research adopts an exploratory/collective nature. The research is exploratory in the sense that it aims to explore the researched phenomenon within the actual context in order to address the influences of various contextual variables on the phenomenon. The exploratory type can generate new theories, as suggested by Yin (2009). The research is collective in the sense that it replicates the research condition by studying multiple cases (eight cases). Such an approach is more likely to strengthen the generalizability claims (Baxter & Jack, 2008; Stake, 1995; Yin, 1994, 2003, 2009; Zainal, 2007). The construction of the research design follows several methodological stages (see Figure 7). The preparation stage, for example, focuses on identifying the process of selecting the cases as well as designing and testing research methods. This stage follows the review of the relevant literature, which is followed by the fieldwork. In conducting the fieldwork, the eight case studies serve as sources of data gathering, where the prepared methods are used to acquire rich data. The analytic stage based on a cross-case synthesis and within-case analysis is then applied. The final methodological stage is concerned with organizing the findings, drawing conclusions, and developing theory and implications.

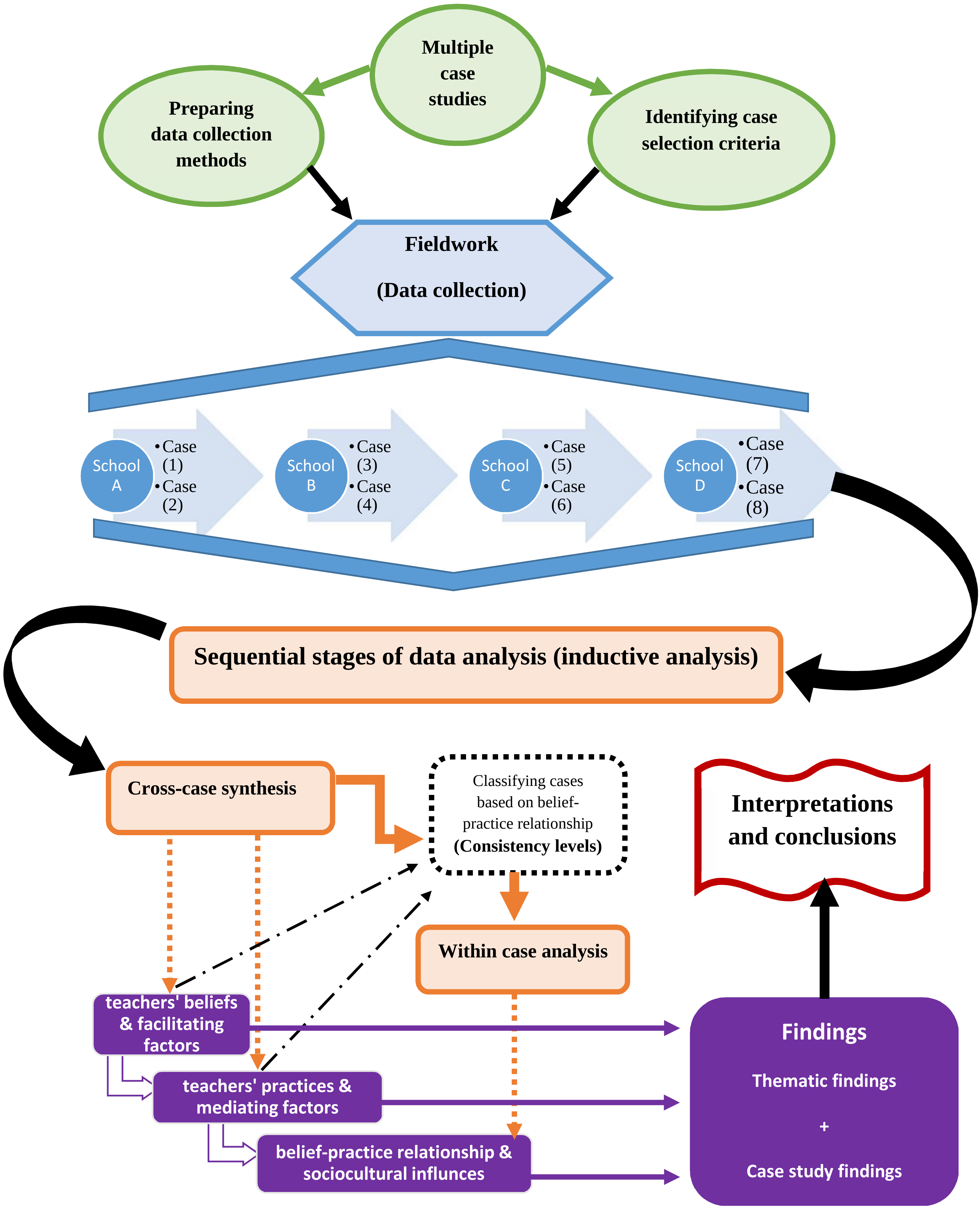


Figure 7: Multiple case studies design

Thus far, this study adopted and developed the research design based on multiple case studies because it fits the research purposes. This particular design was formulated by considering the research gaps in the theoretical framework, the nature of case studies methodology, research questions, case selection criteria, and the cultural principles and customs of the researched context. These considerations are elaborated upon by discussing the research sample, the criteria of case selection, the design of data collection, and the practical procedures of conducting the research.

5.3 Research Sample and Case Selection

The targeted sample includes teachers in intermediate schools specializing in science education and their students. In other words, each case study in the current research consists of a science teacher and his students. Therefore, this section aims to respectively discuss four points regarding the research sample, specifically, the sample technique, the case selection, the application of selection standards, and description of the participants.

Purposeful sampling is a distinctive technique that is used to recruit the participants with the aim to build a theory, in this case, to explore participants and the researcher's interactions. According to Cohen and Manion (1994), this sample is considered non-probability sampling, which refers to several kinds of sampling strategies. The sample strategy in this research relied on the purposive sampling method because the cases were recruited for a specific purpose based on specific selection standards (Cohen, Manion, & Morrison, 2005). Welllington (2000, p. 59) clarified the non-probability sampling strategies by mentioning that "purposive sampling, as its name implies, involves using or making a contact with a specific purpose in mind". More specifically, screening candidates for the case study research is as much a core practice as defining a set of operational criteria for selection (Yin, 2009).

Thus, the science teachers were identified using specific selection standards and selected according to the specific research purposes. Before discussing the selection criteria, it is important here to discuss the students' participation in this study. Students are part of the cases, as each case includes the science teacher and one of his classes. Students have to follow the pedagogical decisions and practices brought about by teachers inside science classrooms. Therefore, students are more likely to be able to triangulate the collected data and add further information regarding what do they do inside the classroom as well as what sorts of classroom practices inspire them to be more creative in science. As a result, their participation can provide valuable data for the study, especially as the relevant empirical work reviewed in Chapter 4 did not document such an important source of data.

With respect to the identification of the purposeful sample, cases meeting specific selection standards should be nominated (Yin, 2009). The selection of participants has to be based on specific standards, as participants are expected to provide answers for the research questions. Although the literature on case studies has strongly emphasised the importance of selecting participants who serve the purpose of the study (e.g., Cohen et al., 2005; Welllington, 2000; Yin, 2009, 2003), recommended techniques for maintaining an appropriately purposeful sample for case studies seems to be lacking. In the current study, while considering possible approaches to reach appropriate participants who can provide rich data, it was determined that the researcher can approach the target participants via sequential procedures. Hence, the cases were selected based on 10 standards in four sequential steps or stages.

Accessibility stage: The aim is to narrow down the screening processes. In the first stage, 46 science teachers from 8 schools were nominated based on the following criteria:

- The ministry of education in Kuwait has six educational governorates, in which each educational governorate manages public schools of Specific County in Kuwait. Thus, the first standard is obtaining accessibility acceptance from one of the six educational governorates to focus on candidates within one educational governorate.
- Contacting schools and obtaining access.
- These two standards should be achieved within 10 working days (2 weeks).

Initial screening stage: The aim is to list science teachers who would be able to provide relevant data for the current research. The candidates selected in this stage comprised 18 science teachers from 5 schools. They met the following criteria:

- The candidates should serve in Kuwaiti governmental schools.
- The candidates should teach intermediate students between 6^{th} and 9^{th} grades.
- The invited candidates should work in male schools and teach science subject.
- The candidates should be nominated by their school administration as an excellent science teacher.

Preference stage: The aim is to ensure the variability among candidates. The second aim is to select candidates who are willing and committed to participate in the study. The potential participants in this stage included 13 science teachers from 5 schools based on two standards:

- Participants had to vary in terms of age, academic background, marital status, years, and types of experiences.
- Teachers had to be willing to participate in the study following our meeting with the science departments of the 5 schools during which we disclosed the fieldwork procedures.

Acceptance stage: The aim is to ensure that teachers and parents sign consent forms. The stage was introduced to maintain the ethical principles and receive participants' consent for taking part in the current study. As a result, 8 science teachers from 4 schools met the acceptance standard and participated in this research.

As stated previously, the methodological choices, including case selection, were developed based on a set of considerations. For example, accessibility was considered in the initial stage. It is pointless to identify a specific individual who can offer relevant data without a guarantee of accessibility. Thus, I had to draw a boundary by receiving access permissions from schools in which the prospective candidates teach.

In the second stage, initial screening focused on the study aims and questions to determine the targeted participants. For instance, this research focused on science teachers in intermediate male schools. The reason for focusing on students in intermediate schools (11 to 14 years old) is that during this chronological period, individuals start to construct their personality and identity, shape clear ideas and sentiments, and build various skills. As a result, students of this age must be enable to recognize their creative potential and demonstrate creative behaviours (Ali, 2000; Hindal, 2007; Sayar et al, 2009; & Sayar et al., 2010). Meanwhile, I focused exclusively on male participants because of the law of gender separation in public schools. The inclusion of female participants would negatively affect the practical procedures of the fieldwork and consume more time due to cultural rules concerning gender privacy, especially as the planned period for data collection is limited to a few months. This limitation is acknowledged and detailed in Chapter 10. In addition, the nomination of the school administration is a significant criterion because science teachers interact with administrators on a daily basis. For example, school principals and their assistants observe and assess science teachers' practices and activities. Thus, they can narrow down the possible cases and offer more relevant cases based on their evaluation and assessment reports.

The preference stage helps ensure the inclusion of a wide range of different experiences about the researched topic. Therefore, the researcher sought to nominate dissimilar cases with regard to age, professional background, academic background, and personal life. Furthermore, the selection standards in this stage focused on the enthusiasm and willingness of the nominated teachers to participate in the study. Participants have the right to withdraw from the study, and apathetic participants might be more likely to request such a right. This standard could decrease the potential of withdrawn cases from the study because they show an optimistic degree of enthusiasm about the research topic and participation. Finally, participants had to sign informed consents to allow the researcher to collect the data for each case. More specifically, the sequential steps identified eight cases from four schools, each case representing a science teacher and one of his classes, as illustrated in Table 2.

Table2. General information about selected cases

Schools	case	Pseudonyms of teachers	age	Teaching experience of the case	Academic background of the case	The grade of observed class	Class size
A	A1	Salem	30	6 years	Bachelor's degree in science	8th	23
	A2	Ali	28	4 years	Master's in special education	9th	21
B	B1	Khaled	28	4 years	graduate degree in biochemistry	9th	24
	B2	Fahad	29	5 years	Bachelor's degree in science education	7th	22
C	C1	Mohammed	39	with more than 16 years	Bachelor's degree in science & math education	7th	25
	C2	Omar	55	26 years	Higher diploma in science of rocks (sedimentary rocks)	6th	24
D	D1	Zayed	33	7 years	Bachelor's degree in physics	8th	23
	D2	Jasser	26	4 years	Bachelor's degree in science education	7th	25

5.4 Data Collection Methods

The application of multiple methods in social science studies has many advantages. For example, exploring a particular context using a single method could lead to limited perspectives about the social phenomena, which in turn yields limited research conclusions; meanwhile, exploring the same phenomena using different methods could help accumulate further enlightenment and elaborate upon the researched context with more in-depth details (Bryman, 2004; Cohen et al., 2007; Robson, 2002). In addition, each research method has not only strengths but also drawbacks; thus, applying more than one method can strengthen the research findings, as some methods can compensate for limitations of other methods (Clark & Creswell, 2008). The multiple methods approach is a form of triangulation because it combines more than one method, and it can triangulate the collected data, thereby strengthening the quality of the conclusion from the interpretive research (Flick, 2009).

Thus, semi-structured interviews, observations and lesson plans, participants' drawings, focus groups, and field notes were the adopted in the current study. These methods are considered the most effective techniques for answering the research questions with rich data. In addition, they facilitate the investigation of the research problem from multiple perspectives. Semi-structured interviews were conducted with science teachers whereas focus groups were conducted with the students. The observations sought to explore the interactions between the science teachers and their students during class or lab activities. Meanwhile, field notes were used to record any interesting and related social events that occurred outside the observation period.

It is noteworthy here that the practical implications of the adopted methods are discussed in section 4.5. Meanwhile, the current section aims to separately articulate and justify the use of the adopted methods.

5.4.1 Semi-structured Interviews (Pre and Post-observations)

Interviews have been perceived as one of the most significant data collection techniques among the qualitative approaches. They enable researchers to access informants' beliefs, wishes, and experiences (Rubin & Rubin, 2005). Three forms of interviews have been commonly applied in educational and social research, specifically structured interviews, unstructured interviews, and semi-structured interviews (Flick, 2009; Robson, 2002). A structured interview includes prearranged questions that are prepared in advance with fixed wording. This method can constrain participants' freedom to evaluate their arguments and responses, which might not lead to rich data. In contrast, an unstructured interview is concerned with the general area of focus without a predetermined schedule in which the conversation develops within the focus area. The final type is the semi-structured interview, which combines the two previous types. A semi-structured interview has the ability to be flexible and at the same time guided in a sense that the interview schedule is predesigned with determinant domains of focus and flexible in the sense that the questions are subject to change and modification during the conversation between the researcher and the participant.

In the current research, a semi-structured interview was applied because it offers more advantages compared to the other types of interviews. It allows the researchers to explore interviewees' feelings, beliefs, and opinions through one-on-one conversation (Wellington, 2000). Consequently, the conversation will not only reveal the participants' ideas, but also evaluate, clarify, and investigate the responses, as Burns (1997) suggested. Nevertheless, the semi-structured interview could have some limitations. One drawback is the limited ability to replicate a focused interview precisely. Interviewees might be asked different questions. Thus, this drawback could be defined during the interview itself. A reminder sheet could address this weakness because it can contain the main questions with enough space for flexibility to add questions based on the interviewee's responses.

In this study, science teachers were asked to participate in pre-observation and post-observation interviews. The pre-observation interview focused on the interviewee's pedagogical beliefs and practices regarding fostering creativity. Three principles were followed to develop the interview's questions. First, a review of related literature on beliefs about and practices for creativity in general education and in science, including studies by Mohamed (2006), and Kamplyis (2010). Second, a review of similar questions designed to match a similar purpose through their interviews and questionnaires, such as studies by Hong and Kang (2010), Lee and Kim (2005), Newton and Newton (2008, 2009a, 2009b, 2010), Park et al. (2006), and Lederman, Abd-Elkhalick, and Schwartz (2002). Third, I determined the questions' relevance to the participants and research questions. For example, some of these studies used primarily close-ended items to measure teachers' beliefs and combined open-ended questions as a secondary source of data collection. The format of these open-ended questions facilitated the enhancement of the current interview by matching the items' formation with previous research (see Appendix A).

Meanwhile, the post-observation interview allowed teachers to clarify and justify their observed classroom activities. The post-observation interview also enabled the research to ask the teachers further questions based on the data from the focus groups, drawings, observations, and field notes. The post-observation interviews were conducted at the end of each case study after applying all other research methods. Further information about the practical procedure used to conduct interviews as well as the other research methods is provided in section 5.5.

5.4.2 Unstructured Observations

Field observation is a remarkable skill that needs to address matters, such as the deception of the individuals being interviewed, impression of the administration, and the possible marginality of the investigator in an unfamiliar context (Hammersley & Atkinson, 1995). The observation took place after the teacher interview in each case.

Bryman (2004) indicated that unstructured observation in social research permits behaviours to be observed directly. This method was applied because it seems to be one of the most appropriate ways to answer the research questions by comparing the teachers' responses in the interviews and their actual pedagogical practices inside the classroom. As Wragg stated, the straightforward query in teacher practices studies is as follows: "'Is the teacher doing what she herself intended?' In this context, classroom observation can be used to match *intent* against *action*" (2012, p. 92). Nevertheless, Wragg (2012) suggested that such observations should not be used as an oppressive measure; rather, they should be followed by brief interviews or a questionnaire to construe issues regarding the observed activity. The current study followed this suggestion by conducting post-observation interviews with the teachers after classroom observations.

According to Koster, Pijl, & Nakken & Van Houten (2010), researchers often use observations to examine the interaction between teachers and students. Wragg (2012) differentiated between observers who tend to concentrate on clear-cut practices and those who tend to address a more complicated concept, such as "creativity, or the extent to which children are able to use their imagination and ingenuity". He also commented on the case of observing creative practice or fostering practice:

> In this case, there could be a specific focus on events thought to be connected with this nurturing of children's inventiveness and originality.' Teacher encourages divergent thinking' or 'pupil produces unusual idea', and the consequences of these acts, are among categories that might be conceived and used in lesson observation (Wragg, 2012, p. 27).

Such a concept could emerge in a particular practice during the classroom observation. Therefore, the non-participation observation style was used in which the observer observes the participants without being energetically engaged with their practices, thereby offering freedom for the observer to make notes. The observation strategy is developed in a way that freely observes classroom practices under specific constituent components of the classroom activity. For example, the targeted behaviours could emerge through teachers' practices and questions, students' answers and inquiry, experiments, group activity, and the like, so that dividing the observation sheets into constituent components or key categories could facilitate the observation and easily recognize the targeted behaviour (see Appendix B). Further information about the methods used to conduct classroom observations is provided in section 5.5.

5.4.3 Focus Group

A focus group is defined as "a research technique that collects data through group interaction on a topic determined by the researcher. In essence, it is the researcher's interest that provides the focus; whereas, the data themselves come from the group interaction" (Morgan, 1997, p. 6). The focus group technique is also considered one of the most appropriate data collection strategies in qualitative research. The usefulness of applying focus group interviews in the current study can be summarized as follows. A focus group is a valuable data collection approach for reflecting a student's point of view about a teacher's activities because it has numerous advantages. Robson (2002) identified nine features of the focus group method: (1) it is a highly efficient technique for qualitative data collection, (2) participants tend to provide checks and balances for each other, (3) group dynamics help focus on the most important topics, (4) participants tend to enjoy the experience, (5) the method is relatively inexpensive and flexible and can be set up quickly, (6) participants are empowered and able to make comments in their own words, (7) contributions can be encouraged from people who are reluctant to be interviewed on their own, (8) people who have specific difficulties are not discriminated against, and (9) facilitation can help in the discussion of taboo subjects.

In this study, this method was used to give students opportunities to share their beliefs, thoughts, and experiences regarding science teachers' activities. In addition, it is helpful for investigating the research focus from various subjective positions. According to Cohen et al. (2005), focus groups might be beneficial for triangulating conventional forms of interviewing, questionnaires, and observations. The focus group technique relies on the communication among participants who converse about a topic posed by the inquirer (Morgan, 1988). Thus, participants interact with the researcher. Another reason for adopting focus group interviews is that participants can raise questions and indicate variables that can be further explained by their teachers. Such group discussion and participation can facilitate the exploration not only by comparing students' ideas with their teachers' ideas, but also by developing further questions for the teacher.

In each case, I asked the students of the observed class to participate in a focus group interview. The maximum number of interviewees was 5 students in each case in order to provide enough time for the students to share their beliefs and perspectives. In each case, four to five students from the observed class agreed to share their perspectives during the focus group discussion following the observations. The focus groups utilized a number of anticipated questions (see Appendix C). The anticipated questions are divided into 4 areas, which are the meaning of creativity, students' opinion about classroom activities, confronted constraints, and the facilitating factors. However, the focus groups were not restricted to these questions. For example, some of the questions asked in a focus group emerged from the observations or pre-observation interviews with their science teachers.

Nevertheless, the focus group method, as with any research method, has some limitations. For example, interviewers might encounter difficulties when organizing their interviewees that in turn increase the possibility of losing control during the focus group. Such a problem was avoided in the current study by limiting the discussion to one-by-one responses to offer enough time and freedom for participants to express their views and comment on the ideas emerging during the interview. Another limitation of focus groups is the time required to transcribe the interviews due to variations in voice pitch and the need to take account of who is speaking. In this case, the interviewees were asked to introduce themselves before sharing their views and answering the research questions to facilitate the analysis and avoid any confusion with respect to who was speaking. The researcher also transcribed the verbal data for each focus group immediately following the focus group. Students' drawings were then attached to the focus group transcriptions. Further information is provided in section 5.5.

5.4.4 Conceptual Drawing

Although interviews and focus groups are effective methods for interacting with participants and gaining valuable oral data, other applications could increase the effectiveness of these interactive procedures. More specifically, conceptual drawings can elaborate on the data obtained from the conversations between interviewer and interviewee. It has been argued in recent research that drawing can be a significant source of data that expresses the insights and understandings held by individuals (Stanczak, 2007) because it offers a great opportunity for reflecting on one's beliefs, experiences, knowledge, and practices via critical lenses (Baum & Berg, 1993).

According to Baum and Berg (1993), drawing could be a useful for both educational and research purposes. For instance, different educational scholars have argued that drawing can be a significant pedagogical tool integrated into classrooms (e.g., Anderson, Ellis, & Jones, 2014; Baum & Berg, 1993; Chappell & Craft, 2011; Haney et al., 2004). Conceptual drawings involve the conceptual knowledge of students (Anderson et al., 2014), stimulate reflective engagements in the classroom (Haney et al., 2004), and generate creative learning dialogues (Chappell & Craft, 2011). Scholars have also asserted that drawings are significant for educational research. For example, Chappell et al. (2011) argued that visual representations in drawings could be used to build more focused conversations about specific experiences of a participant. Similarly, Anderson et al. (2014) used children's drawings to explore their knowledge of plant structures, revealing that they are a rich source for documenting students' thinking.

This study applied conceptual drawings for five reasons: (1) to explore the participants' beliefs and practices; (2) to triangulate the interview, focus group, and observation data; (3) to gather multiple reflections on participants' beliefs of fostering creativity in science classrooms and their actual practice; (4) to raise further fieldwork questions to gather rich data; and (5) to offer the opportunity to visualize participants' data and not be limited by one way of expression, such as oral engagements. Drawing can be conducted singly, such as with the teacher in the pre-observation interview, or in a group, such as with students in focus groups (Chappell & Craft, 2011). This method was applied during pre-observation interviews with teachers in which the teachers were asked to visualize their beliefs about how to foster creativity in the current science classroom context. Additionally, the students who participated in the focus group were asked to express their perspectives through drawing. They were asked to draw stimulating science classroom activities that help them to be creative. The reason for combining participants' drawings with verbal documentation is that drawing needs to be attached to comments and discussions to reveal the story behind the visual representations (Anderson et al., 2014). In addition, the activity also allows participants to include written comments in their drawings. Further information regarding the practical procedures of applying conceptual drawing technique is provided in section 5.5.

5.4.5 Field notes

Field notes are likely to make further contributions to understanding what is happening in the researched context during the fieldwork. According to Flick (2009), this method helps document further experiences, problems, information, and personal reflections about the researched phenomenon as well as the processes of data gathering. Regularly written notes can also be used as memos to be transferred into the analysis process and facilitate the process of drawing conclusions and making interpretations (Flick, 2009).

This study used field notes, which were valuable for recording any interesting notes during the fieldwork journey. This method was able to highlight related events occurring outside the classroom, during the interviews, and during teachers' interactions with their colleagues and to include teachers' sentiments regarding the activities or even regarding their participation in the study. At the same time, field notes can draw attention to students' comments and behaviours outside the observation hours. Using this method, the researchers were able to reflect their views and thoughts about the activities occurring in the researched context. Field notes can be taken from the beginning of the research process until the end of the data analysis. During the fieldwork, the researcher used the notes to summarize on-site days, focusing on relevant actions and details about the case, including reflections on what happened on site. This method played an important role in collecting rich and deep data for several reasons, namely: (1) it raised further questions to be asked later; (2) it covered new justifications, declarations, ideas, and examples not mentioned by interviewees; (3) it did not require audio recordings or notebooks to immediately document the actions; and (4) it was not limited to a particular time, such as interviews, focus groups, and observations, meaning participants could come up with further details at any time during the workdays.

5.5 Practical Procedures of the Data Collection

Conducting the study involved a series of fixed actions organized into a fixable plan. Actions, such as data collection preparation, ethical clearance attainment, accessibility and case selection, participants' agreement, and a timetable for conducting fieldwork were practical applications for ethically and appropriately collecting the necessary data. The aim of this section is to provide further information about the practical procedures of the fieldwork. Three key procedures are highlighted here: obtaining approvals to access the contexts, preparing the data collection methods to be carried out, and applying the methods during the actual data collection.

5.5.1 Procedure 1: Permissions, Accessibility, and Case selection

Carrying out the current study required sequential permissions and approvals. With respect to ethical clearance, the researcher completed a certificate of ethical research approval from the Graduate School of Education at the University of Exeter. This ethical form highlighted general information about the research aims, questions, participants, time, and ethical considerations to be approved by the school's ethics committee at the university (see Appendix D). Once the ethical form was approved, the supervisor prepared a fieldtrip letter to be sent to the Kuwaiti cultural office in London to get permission for the researcher to travel back to Kuwait and collect the data. The cultural office sent another letter to the researcher's scholarship sponsor to inform the sponsor about the field trip. Then, the scholarship sponsor wrote a third letter to the Ministry of Education in Kuwait.

At the Ministry of Education, the researcher had to present the research methods to the administration of Educational Research and Curricula Development (ERCD) to examine their appropriateness and ensure the ethical considerations of the research. The department then printed out six letters to be sent to the public managers of educational governorates to facilitate access to intermediate schools.

The researcher then received a copy of a public leaflet that was sent to all intermediate male schools in a particular educational governorate (i.e., the educational governorate of Mubarak Al-Kabeer). All these permissions and accessibility letters are respectively provided in Appendix E. The researcher then visited the schools and started the process of identifying the research sample based on the four stages of case selection criteria, as discussed earlier in this chapter (see section 5.3 for information on the research sample and case selection).

5.5.2 Procedure 2: Translating and Piloting Methods

This procedure aimed to develop the research methods. While receiving approvals and permissions, the researcher established another key procedure to save time and initiate the actual data collection as soon as possible. The researcher was keen to translate and test the methods of data collection while selecting the research sample.

With respect to the translation, the teachers' interview schedule and students' focus group schedule were developed in English language to fit the purpose of this study; however, English language is not the first language of the research sample. Consequently, the researcher translated these schedules into Arabic language as the first Arabic copy. In addition, a professional English language teacher subsequently retranslated the English copy into a second Arabic copy to compare the two Arabic copies, review the efficiency of translation, and modify ambiguous questions. This process enabled the researcher to modify the research tools that needed translation in a way that adhered to cultural and linguistic precision. The remaining research methods (i.e., observational sheets and field notes) did not require translation.

After the linguistic revision process, a pilot study was conducted during the first two weeks of November 2012. According to Robson (2002), a pilot study is a preliminary trial of the main study to illustrate its practicability. In particular, it can assist the researcher in refining data collection plans through both the content and practical applications of the data (Yin, 2009, 2003). Thus, the researcher conducted a pilot test to examine a number of issues, such as to estimate the time needed to conduct the study, find the misleading and unclear questions, check practical applications, and discover any technical problems that may emerge when using tools to record voice pitches, for example.

One science teacher and his seventh-grade students participated in the pilot study to provide feedback about the research methods. The researcher conducted a pre-observation interview with the teacher, which lasted around 32 minutes, followed by a 20-minute discussion with him to gather reflective feedback about the interview and its questions. Similarly, five students participated in a focus group and completed the drawing activity, which lasted around 21 minutes. After the completion, we gathered students' feedback to the questions and assessed the management of the focus group discussion. In addition, three full lessons were observed (45 minutes for each lesson) to determine the workability of the observation schedule. The researcher tested the observation method with another researcher (a senior chemistry teacher and PhD holder in chemistry education) to compare the notes from both observations; these observations were followed by a discussion between the observers to identify problems and revise them.

The pilot study contributed to addressing and revising possible difficulties with data collection practices and refining the research methods and their practical administrations. For example, the feedback from both teachers and students who participated in focus groups highlighted the confusing and ambiguous questions, which were modified in terms of wording and meaning. Another benefit of this procedure was the ability to estimate the time required to conduct interviews and focus groups. It also helped to determine the time necessary to collect visual data (drawings) to enhance the administration of the data collection methods. A further advantage related to method administration was that the focus group pilot test allowed the researcher to determine on the management of the group discussion, such as develop the clarification-seeking questions to build on or elaborate upon interviewees' ideas in the focus group. Furthermore, the pilot study refined the observation schedule and modified the observation sheet to make notes more easily during the observed classes. The observation approach is not a structured one; however, the initial observation sheets combined a number of headlines, such as laboratory organization, teacher's movements, students' interactions, and educational aids used in the class. Thus, the piloted observed lessons generated better sheets for making notes and reflective comments.

5.5.3 Procedure 3: Main Study Fieldwork

The data from the main study were collected from December 2, 2012, to the end of April 2013. Once the accessibility permissions, case selection, and pilot study were completed in late November 2012, the researcher started the main data collection stage (see Appendix F for the timetable of the main data collection). Regarding the practical processes within each case, the study aimed to conduct the research methods sequentially, as illustrated in Figure 8.

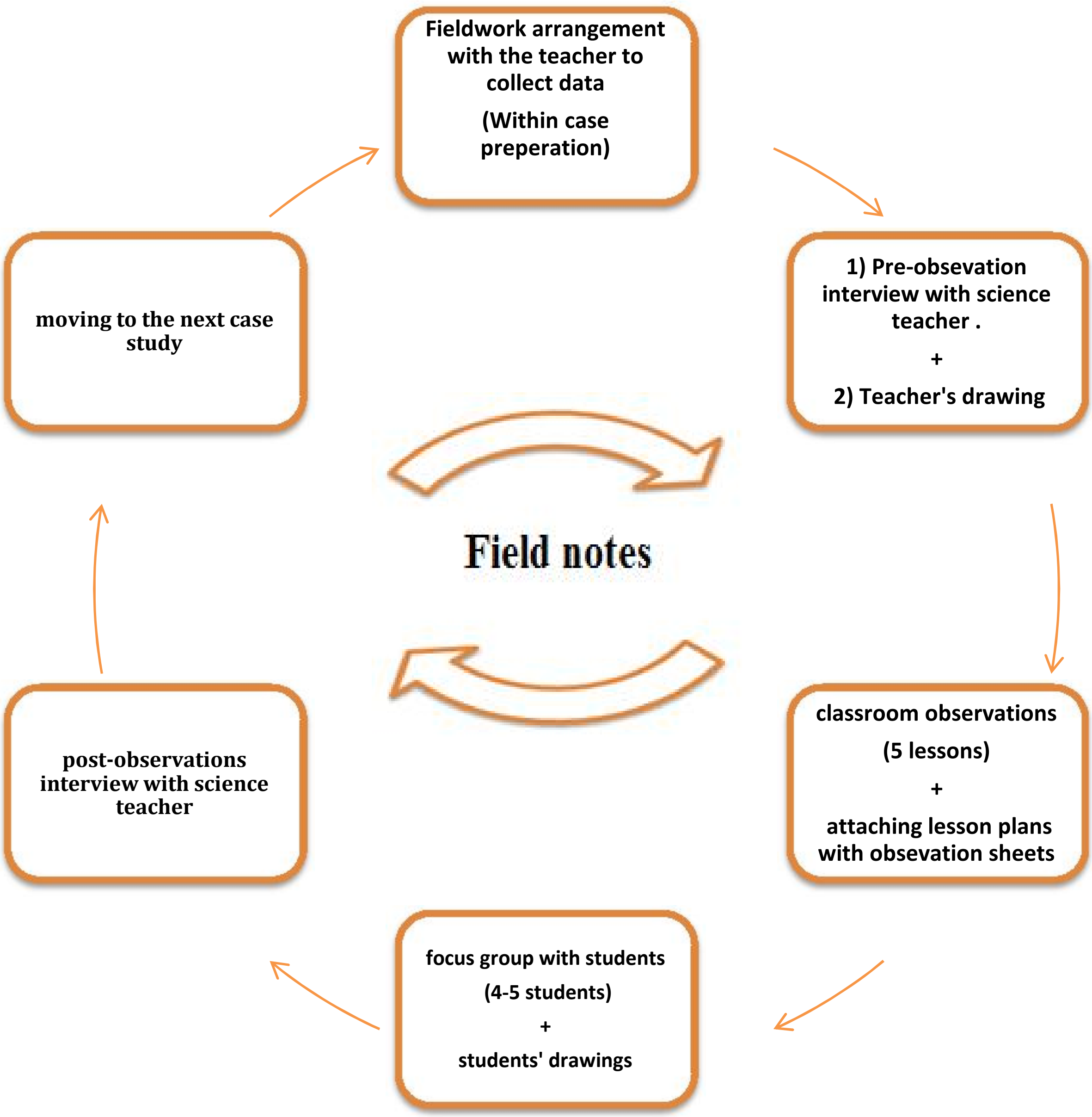


Figure 8: Process of conduction research methods within each case study

This sort of approach would lead to more systematic fieldwork engagement that could help elaborate the emergent data within each case and then accumulate rich data. It enables the researcher to collect reflections about specific actions and answers questions that emerge during the fieldwork.

Each method followed a specific protocol to ensure ethical and methodological principles. It was essential to refer to these practical protocols and the overall information to conduct the research methods. For example, the teachers' interviews consisted of before and after observations. The pre-observation interviews lasted between 22 and 47 minutes, but commonly over half an hour. Meanwhile, the post-observation interviews lasted between 15 and 25 minutes, but most lasted for more than 20 minutes (see Table 3). Both pre- and post-observation interviews were face-to-face; however, different rooms were used for the interviews depending on the availability.

Table3. Information about teachers' interviews

Interviewee (Pseudonyms)	Pre-observations interview			Post-observations interview		
	Duration	Place	Mode	Duration	Place	Mode
Salem	33.37 mins	Laboratory	Face-to-face	15.22 mins	Laboratory	Face-to-face
Ali	47.44 mins	Laboratory technician office	Face-to-face	23.39 mins	Laboratory technician office	Face-to-face
Fahed	27.54 mins	Laboratory technician office	Face-to-face	21:22 mins	Laboratory technician office	Face-to-face
Khalid	33.59 mins	Laboratory	Face-to-face	24.54 mins	Office	Face-to-face
Mohammed	32.23 mins	Office of head science teacher	Face-to-face	20.42 mins	Office of head science teacher	Face-to-face
Omar	30.5 mins	Office of head science teacher	Face-to-face	25.24 mins	Researcher's home	Face-to-face
Zayed	22.06 mins	Laboratory technician office	Face-to-face	25.19 mins	Laboratory	Face-to-face
Jasser	26.46 mins	Office	Face-to-face	18.25 mins	Laboratory	Face-to-face

One day before the interview, the researcher confirmed with the participants that the arranged interview time was still convenient for the teacher. The door to the interview room was closed and an A4 piece of paper was hung on the outside to inform others that the room was occupied. The language spoken during the interviews was Arabic (Kuwaiti dialect). The interviews were recorded via a digital audio recorder. The digital data were transcribed and transferred from verbal data to literal data and subsequently inserted into MaxQda11.

Students' focus groups also followed the same procedures as the teachers' interviews. However, the researcher had a limited time, approximately 45 minutes (one teaching session), to conduct the focus groups. The first 5 minutes were usually spent on transferring the interviewees from their original class to the place where the focus group was conducted. Once the students arrived for the focus group, the researcher spent about 5 minutes informing the interviewees about the nature, purpose, and process of the focus group activity and drawing activity while reminding students about their rights. Subsequently, the focus group discussion was conducted and recorded and drawing materials provided to students. During the last 5 minutes, students were asked to complete their drawings and submit them to the researcher.

Table4. General information on students' focus groups

Teacher (Pseudonyms)	Class's grade	Number of students	Place	introduction (in mins)	recorded discussion (in mins)	Extra time (in mins)	Pseudonyms of interviewees
Salem	8^{th}	5	Laboratory	5	13:52	5	Bader, Hassen, Jaber, Othman & Jamal
Ali	9^{th}	4	Laboratory	5	12:36	5	Samir, Fiasal, Rathi,& Falah
Fahed	6^{th}	4	Laboratory technician office	5	16:50	5	Tareq, Thamer ,Yassin, & Jarrah
Khaled	9^{th}	4	Laboratory	5	16:11	5	Salman, Saleh, Rashed, &Talal
Mohammed	7^{th}	4	Library	5	23:34	5	Fadi, Faleh, Jassim, & amer
Omar	6^{th}	5	Library	5	16:41	5	Waleed, Rabeh, Majed, Nabeel,& Diage
Zayed	8^{th}	4	Laboratory	5	17:29	5	Mishal, Hamzah, Sami, & Thari
Jasser	7^{th}	4	laboratory	5	14:17	5	Fathel, Essa, Samir,& Ahamed

Briefly, the participants were introduced to the drawing activity before starting the interviews or focus groups to make them familiar with the activity and its purpose. For example, the purpose of teachers' drawing was to reflect on how they could foster their students' creativity in the science classroom; meanwhile, the purpose of students' drawing was to reflect on what sorts of activities inspire and stimulate them to be creative in the science classroom. Certain materials for the drawing activity were provided, such as A4 paper, pencils, and coloured pens, for the use by the interviewees.

Concerning classroom observations, 40 classroom sessions (five 45-minute lessons within each case study) were conducted following the lesson plan prepared by the teachers. The observations included a number of features that triangulated the data collection and enabled the researcher to observe the participants' actions in the researched context. However, observations, as a data collection method, have some limitations. For instance, participants might feel uncomfortable or threatened by having their work scrutinized. In such cases, participants might change how they act or behave (e.g., Bryman, 2004; Cohen et al., 2005; Flick, 2009; Wellington, 2000).

Therefore, the researcher attended six lessons within each case. In addition, attendance in the first class did not include any observational tasks, but rather helped the researcher orient himself to the class and build a rapport with the teacher and the students, thereby allowing ordinary engagement in their context. After the non-observational attendance, the classroom activities were formally observed during the remaining lessons, as illustrated in Table 5.

Table5. General information about the observed lessons

Teacher (Pseudonyms)	Grade	Observed lesson 1	Observed lesson 2	Observed lesson 3	Observed lesson 4	Observed lesson 5
Salem	**8th**	Weathering and Erosion	Chemical Weathering	Weathering rate	Soil formation and composition	Soil horizons
Ali	**9th**	Atom structure and quantum numbers	Quantum Numbers	The electronic distribution	Pauli exclusion principle	Hund's Rule
Fahed	**6th**	Structural and behavioural adaptations	Fossils	Fossils	Soil components	Natural life and environment
Khalid	**9th**	Rutherford's model	Bhor's model	Electronic distribution	Electronic distribution	Law of mass conservation
Mohammed	**7th**	Gravity	Motion	First law of motion	Second law of motion	Third law of motion
Omar	**6th**	Splitting Water - Electrolysis Experiment	Mixtures and solutions	Description of substances and natural changes	Chemical features and changes of substances	Physical and chemical changes
Zayed	**8th**	Mollusca	Arthropods	Types of Arthropods	Insects	Insects' development
Jasser	**7th**	Prokaryote	Types of Prokaryote	Kingdom of Protista	Protozoa	Types of protozoa

5.6 Data analysis

By reviewing the qualitative research literature, the researcher identified a great number of data analysis strategies. All of these strategies seemed to share the key analytic phases, such as preparing the data, coding and deconstructing the data, and assembling and organizing the data. Miles and Huberman (1994) suggested three procedural analytic stages: management, reduction, and data display. The first stage called the management stage represents the process of retrieving and systematizing the raw data by following specific steps, such as transcribing, editing and recording notes, and inserting data in computer or textual records. The second stage, reduction stage, is based on the researchers' review of the data and recording memos about codes induced from the data. The final stage, as suggested by Miles and Huberman (1994), is data display, which is concerned with clustering the codes into segments and collecting the segments to draw meaningful conclusions. Miles and Huberman's (1994) three stages can be used as the fundamental stages for the analysis of the current study. Such an approach facilitates the analysis of the raw data and helps develop a more systematic strategy. Based on these stages, the researcher was able to derive meaningful and justified interpretations. Thus, the researcher adopted these key stages to discuss the aims of each stage and the underlying analytic processes applied in the current study.

Two aspects that need to be discussed before moving on to the analysis stages and their processes are the nature of the data analysis and the nature of the raw data. Regarding the data analysis, the analysis was based on induction in the sense that the analysis was established and developed according to the open coding process to create preliminary themes regardless of the previous literature and without the existence of pre-determined categories. In other words, the themes and categories were derived from the raw data by retrieving, reproducing, and classifying the preliminary themes.

The other aspect was the nature of the raw data. The raw data were collected in Kuwaiti contexts, where Arabic language is the participants' mother language. Thus, translating the raw data could affect the quality of the collected data. For example, Roger and Lee (2005) argued that "the trustworthiness of the qualitative analysis is potentially increased when the analysis is done within the original language of the data collection" (p. 9). This argument is based on maintaining three features of the analysis within the original language: (1) accurate rendition: pursuing the sense of the data as occurring in the event; (2) holistic analysis: the cultural means and expressions should be made comprehensible and clear; and (3) individuality: "'voice' of individual participants [is] retained" (p. 8). Therefore, the current study did not attempt to translate the data for analytic processes. However, codes selected to interpret the findings were translated into English after the data analysis.

4.5.1 Management Stage

First, the management stage is a long-term process that begins with the commencement of the research and continues through the analysis phase. According to Miles and Huberman (1994), it is not easy to divide the data analysis from the data collection phase. Specifically, during the data management stage, researchers interact with the collected data by adding notes, writing memos, transcribing interviews, and defining a preliminary impression of transcripts (Maxwell, 1996). This stage helps the researcher not only manage the collected data, but also administer the entire analysis. Therefore, the researcher focused on four steps in this stage that require careful attention to ensure an adequate analysis—namely, preparing raw data, transcribing the audio data, retrieving the data and research questions, and applying a software programme as an assistance tool.

The raw data were classified, labelled and entered into a database for each case context, followed by transcribing audio materials from teacher interviews and focus groups. After systematizing the data, the researcher tended to engage with the responses to develop preliminary comprehension of the researched contexts. The retrieval step took into account the research questions for using initial memos in the coding stage.

The fourth step involved a software programme to facilitate the manifestation of the data and rearrange the responses according to the researcher's needs. According to Flick (2009), researchers have several expectations when applying software programme to analyse the qualitative data. They are primarily concerned with saving time, enhancing data management, and facilitating the data representation. Kelle (2000) identified six steps before analysing empirical materials using a software programme: (1) formatting textual data; (2) carrying out open coding; (3) writing memos and attaching them to text segments; (4) comparing text segments to which the same codes have been attached; (5) integrating codes and attaching memos to codes; and (6) developing core categories (cited in Flick, 2009, p. 368). A qualitative data analysis not only deals with textual materials, but also enables the user to analyse visual and audio materials. All these facilities encouraged the researcher to apply the NVivo 10 programme, although this programme cannot efficiently deal with Arabic texts. Therefore, the researcher explored and compared the features of similar software programmes, such as ATLAS.ti7 and MAXqad 11. Ultimately, MAXqda11 was chosen for the current study because it can operate normally when attempting to use right to left languages (e.g., Arabic and Hebrew). As a result, all the raw data were imported into the programme in order to start the coding stage.

5.5.2 Coding Stage

This stage addressed the core analytic engagements with the collected data. According to Coffey and Atkinson (1996), coding is “a mixture of data reduction and data complication. Coding generally is used to break up and segment the data into simpler, general categories and is used to expand and tease out the data, in order to formulate new questions and levels of interpretation” (p. 30). Practically speaking, researchers can code phrases, words, sentences, or whole answers, and these codes can be identified in several ways based on the type of questions asked, participants, data collection methods, and so on. This is not a random process in which the researcher highlights and labels segments of data to be demonstrated later. Rather, it should be in line with the philosophical assumptions of the study and follow the systematic steps leading to the conclusions. Thus, it is important to make a decision about how the researcher will code and identify themes. Therefore, the thematic analysis model proposed by Braun and Clarke (2006) was adopted in the current study. These researchers suggested that qualitative data could be analysed using six steps. A systematic example of the data analysis process was created to manifest the thematic analysis model (see Appendix G).

The first step of this systematic stage is *familiarization*. This step is interconnected with the management stage in which the researcher becomes familiar with the data. The researcher familiarizes himself with the raw data by listening to the verbal data and reviewing the accuracy of transcripts, rereading the raw data, and writing general notes and indicators to be used in the subsequent steps. The researcher intends to keep recording his thoughts in the form of memos. As Wellington (2000) stated, writing notes guides the researcher in managing and making sense of various answers, thereby facilitating the process of coding responses and identifying key themes.

Generating preliminary codes is the second step in the open-coding process. The codes are attached to the segments of the data to classify and label different units of meanings and ideas. These codes summarise the segments of the data, such as phrases, words, sentences, or whole answers. The researcher reviewed the data and created the codes without predetermined categories or themes by focusing on the entire data, regardless of the findings and conclusions of previous studies.

The third step involves *searching for themes*. The emergence of themes or categories is a result of assembling these codes into smaller numbers of sets, themes, or constructs (Miles & Huberman, 1994, p. 69). Codes are sorted according to their relevance into clusters. The fourth step involves *reviewing themes*. In this step, some themes not supported with enough codes are refined and reconsidered for their feasibility as themes. Meanwhile, other themes were broken down to create sub-themes. Similarly, some themes are integrated to create unified themes because their codes share similar meanings. Therefore, the nominated themes produced in the previous step are subject to improvement. In the current study, the researcher refined the themes and categories by checking the relevance of codes to each theme and differentiating among the themes. Taylor-Powell and Renner (2003) called it iterative process because this step enables the researcher to reread all codes and themes and then compare them with the raw data set. The purpose of this step is to form a coherent pattern within each theme as well as distinctive and identifiable units of meanings cross-themes.

Defining and naming themes is the fifth step that leads to a further and deeper development of the themes or categories. Braun and Clarke (2006) explained that "by 'define and refine', we mean identifying the 'essence' of what each theme is about (as well as the themes overall), and determining what aspect of the data each theme captures" (p. 92). The researcher in the current study intended to describe each theme and its role with respect to the whole data, including the development of previous thematic maps. In this step, thematic connections become clearer and identifiable, in turn demonstrating the story beyond the raw data. According to Miles and Huberman (1994), this is a theory-building level in which the codes are tied into identifiable clusters to demonstrate that the raw data are instances of a major notion.

The final step involves *producing the report*. This concerns answering the research questions and drawing argumentative conclusions supported by satisfactory evidence from the data. This step appears to be directly related to the stage of data display; therefore, further discussion is carried out in the data display stage. In the current study, the researcher explained how and why the research questions are answered by applying cross-case synthesis (thematic) and within-case analysis (case studies) approaches.

5.5.3 Data display stage

In this stage, the researcher identified the themes based on two techniques: cross-case synthesis and within-case analysis. Both techniques play a role in answering the research questions. For example, the cross-cases synthesis accumulates the themes and categories of the cases to define similarities and differences among them. Yin (2009) suggested a cross-case synthesis approach that "applies specifically to the analysis of multiple cases" (p. 156). His suggestion appeared to be relevant to the current research design. In this respect, synthesizing themes and codes across cases can support similar clusters, draw conclusions from multiple contexts, identify new clusters, and build a cross-case theory. As Yin (2009) explained, "the technique treats each individual case study as separate study. In this way, the technique does not differ from other research syntheses-aggregating findings across a series of individual studies" (p. 156). The aim of this method is to draw findings from the first four questions in order to define the common pedagogical beliefs, sociocultural sources, actual pedagogical practices, and mediated sociocultural elements between their beliefs and practices (see Table 6).

Table6. Themes and categories emerged from the thematic analysis

N	Open coding	Instruments of data collection						grouping codes	Building thematic map	Relevance to RQs
		Interview 1	Teacher drawing	observations	Interview 2	Focus group	Students' drawings			
1	Creativity is originality	√			√	√		Aspects of creativity	Teachers' conceptions of creativity	Teachers' Pedagogical beliefs regarding fostering creativity in science classroom **(RQ1)**
2	Creativity is usefulness	√								
3	Creativity is imagination	√	√			√				
4	Creativity is for all people	√			√			Creative potentiality		
5	The NoS comprises creativity	√	√		√			Creativity is a NoS aspect		
6	Guided inquiry fosters creativity	√				√	√	Inquiry-based learning Approach	Teachers' beliefs about pedagogical approaches that can foster students' creativity in science classroom	
7	Open inquiry fosters creativity	√	√		√		√			
8	Group works foster creativity	√	√		√	√	√	Cooperative learning approach		
9	Dialogues foster creativity	√	√		√					
10	Playful activities foster creativity	√			√					
11	Reasoning skills	√	√		√	√	√	Teaching thinking skills		
12	Questioning skills	√	√		√					
13	Problem solving skills	√			√					
14	Brainstorming skills	√								
15	Conducting lab experiments	√	√		√	√	√	Practical investigation approaches		
16	Providing sufficient time	√	√		√			Educational setting-related factors	Required factors to apply pedagogical approaches for fostering students' creativity (teaching for creativity)	Facilitating factors for fostering creativity in science classroom **(RQ2)**
17	Encouraging teachers' and students' freedom	√	√		√					
18	Integrating modern ICT	√	√		√	√	√			
19	Availability of extrinsic motivation	√	√		√	√				
20	Tolerant to ambiguity (risk taking)	√						Student-related factors		
21	Curiosity and interest	√				√				
22	Differentiating teaching practices	√	√					Teacher-related factors		
23	Linking informal and formal science learning	√	√		√					
24	Creating friendly relationship with students	√				√	√			

Table 6. Themes and categories emerged from the thematic analysis

N	Open coding	Instruments of data collection						grouping codes	Building thematic map	Relevance to RQs
		Interview 1	Teacher drawing	observations	Interview 2	Focus group	Students' drawings			
25	Teachers' focus on delivering textbook information	√		√	√	√	√	Teachers' goal orientation	The classroom practices	Current pedagogical practices inside the context of science classroom **(RQ3)**
26	Teachers' focus on preparing students for examination	√	√	√	√	√				
27	Giving long lectures and data show presentations	√	√	√	√	√	√	Intensified teacher-centred activities		
28	Short teacher -student dialogues			√		√		Modest student-centred activities		
29	Short Group work activities			√		√	√			
30	Practical experiments			√		√				
31	homework based on guided inquiry technique			√						
32	Conducting open inquiry projects			√	√	√		Extracurricular practices		
33	Cooperative science teams			√	√					
34	Outdoor activities & trips			√	√	√	√			
35	Absence of creativity assessment				√			External constraints	Barriers of putting teachers' beliefs into classroom practices consist of three types of constraints	The sociocultural factors perceived by science teachers as mediating factors that mediate their beliefs and practices **(RQ4)**
36	Heavy textbook content (huge curriculum laden)				√	√				
37	Restricted syllabus				√					
38	Lack of time			√	√					
39	Lack of relevant resources			√	√	√				
40	Feeling stressed and overloaded				√	√		Personal constraints		
41	Teachers' control	√	√		√					
42	Teachers' lack of knowledge regarding creativity				√					
43	Lack of professional training				√			Interpersonal constraints		
44	Weak link with experienced institutions				√					
45	Parental attitude toward education		√		√					
46	Disruptive behaviors				√	√				

Meanwhile, to address the final question about the consistencies and inconsistencies of teachers' beliefs and practices, the researcher used a within-case approach to compare teachers' beliefs and practices as well as identify the sociocultural influences on the belief–practice relationship. This approach was based on the following analytic steps:

(1) Classify the levels of teachers' beliefs.
(2) Classify the levels of teachers' practices.
(3) Identify the belief–practice relationship based on the previous two steps.
(4) Group the cases according to the third step (the level of belief–practice relationship).
(5) Present exemplary cases of each belief–practice level.

Further discussion of these five steps is provided in Chapter 8 (case studies findings) to address the level of consistencies and inconsistencies.

5.7 Research Quality and Ethics

The metaphysical worldviews went beyond the distinctive weight on the three assumptions of ontology, epistemology, and methodology to highlight moral and ethical considerations (Mertens, 2010; Morgan, 2007) and to ensure that "good research" was conducted to fit the nature of the metaphysical world. Researchers practice good research according to their philosophical insights about the social world (Christians, 2005). Each worldview embraces criteria to culminate in good research based on honesty, trustfulness, and morality. In addition to the specific criteria of these worldviews, research organizations, such as BERA in the UK and EERA in the US, have generated general guidelines to assist researchers in their plans based on these moral principles (Merten, 2010). Consequently, the following section discusses the position of the current study concerning quality criteria as well as ethical considerations.

5.7.1 Research Quality (Trustworthiness)

Interpretive research views honesty and truthfulness as contextual issues. Since the mid-1980s, an attempt has been made to construct criteria for evaluating different interpretive research. Lincoln and Guba (1985) created several concepts to assess the quality of interpretive research, including trustworthiness, credibility, dependability, transferability, and confirmability .Trustworthiness is the main criterion among these quality criteria (Flick, 2009; Lincoln & Guba, 1985). This criterion reflects traditionally discussed issues of validity and reliability (Seale, 1999). For example, these alternative criteria—namely, credibility, transferability, dependability, and conformability—are parallels of internal validity, external validity, reliability, and objectivity, respectively (Flick, 2009; Lincoln & Guba, 1985; Merten, 2010). Thus, the following paragraphs discuss some of these quality criteria and the ways in which they were used to enhance the research quality.

5.7.1.1 Credibility

In terms of credibility, several techniques can be used to ensure research credibility, such as triangulation, member checks, peer debriefing, and prolonged and persistent engagement (Flick, 2009; Lincoln & Guba, 1985; Merriam, 1998; Merten, 2010). The existing literature has indicated that triangulation is the most broadly focused validation tactic in educational research (Denzin, 1988). Stake (1995) encouraged the triangulation method in interpretive research because it can ensure precision and substitute enlightenments. Although triangulation has many forms, the most common form is applying multiple methods (Cohen et al., 2005). Accordingly, the current research applied interviews, observations, focus groups, conceptual drawings, and field notes as data collections. In addition, the sample was not limited to science teachers, but included also their students, which is a kind of triangulation in the sample. These applications in the current study can improve the trustworthiness of the research findings (Lincoln & Guba, 1985).

Another application to enhance the creditability of the research is prolonged and persistent engagement. The researcher should spend a satisfactory amount of time in the field and conduct a sufficient number of observations to avoid making premature conclusions (Lincoln, 2009). In this study, the fieldwork plan was flexible in that it allowed the researcher to spend more time in the context until he believed that the data collected could identify the themes. The researcher was also aware of holiday times to devise a schedule that would give him enough time to engage in the investigated field. Thus, triangulation and prolonged and persistent engagement were adopted to ensure credibility, although the research also included other trustworthiness criteria.

5.7.1.2 Transferability

Transferability parallels external validity (generalization); however, the interpretive research views the sample as contextual issue rather than a representation of the population. Thus, transferability "enables readers of the research to make judgments based on similarities and differences when comparing the research situation to their own" (Merten, 2010, p. 259). Providing a detailed description of the researched phenomenon seems to be a key principle to allow others to make adequate judgments about the current research and determine whether the research findings can be transferred to their circumstances. In this regard, generalization is not assumed in this study; rather, the researcher sought to present an extensive description of the cases by collecting extensive demographic information, such as participant background, time, context, culture, rules, and location. This is more likely to help readers apply transferability and compare between the current work and their own. Second, applying multiple cases can increase the transferability (external validity), as Yin (2009) suggested. He recommended that applying the logic from the replication technique, in which the findings are replicated in multiple case studies, could strengthen the external validity. In this regard, such a technique can support the claimed conclusion of the study.

5.7.1.3 Dependability

Dependability parallels reliability; however, it should be openly examined. According to Flick (2009), the practical rationality of conducting research and drawing conclusions should be delineated to maintain dependability. To audit the research dependability in the current study, the researcher explained the research process and provided justifications for the methodological and practical decisions, analysis processes, and findings. Yin (2009) suggested that the researcher should take several operational steps to conduct the research with a clear pathway and base that enable others to replicate the findings. Yin believed that applying case study protocol and having a case study database can help sustain the study's reliability. Flick (2009) asserted that dependability can be verified through several points, such as the use and piloting of the methods, raw data, the collection process, data reduction, results of reduction, description of the cases, and reconstruction of the data as well as the result of syntheses, the development of categories, and methodological and axiological concerns (pp. 392–393). These areas are explained and supported during the development of the current research by allowing external users or reviewers to verify the study's trustworthiness in general and its dependability in particular.

5.7.1.4 Confirmability

Confirmability parallels objectivity, in which the conclusions are not drawn based on the researcher's values and imagination (Merten, 2010). Instead, the interpretation of the data should follow a clear logic and the collected data should be derived from its source (Guba & Lincoln, 1989). The confirmability audit could be achieved by asking one colleague to analyse one case to determine whether appropriate data support the findings.

Peer debriefing was an essential technique in the current study in which the researcher asked another researcher (a PhD holder in chemistry education) to code and analyse part of a teacher's interview, one classroom observation, and part of a focus group interview after ensuring confidentiality of the interviewees and participants. The results of both researchers were then compared. The researcher examined whether the other researcher produced similar codes for similar sets of units. This process was followed by discussion between both researchers to examine the results of the two materials; this application helped the researcher face his own values and provide additional insights on dealing with the data analysis procedures (Merten, 2010, p. 257).

5.7.2 Ethical Concerns

Ethics are seen as constituent components of good research (Clark & Creswell, 2008; Mertens, 2010). Addressing ethics during research can lead to conclusions with an adequate degree of ethical satisfaction. Researcher should consider a number of moral values as guidelines for ethically covering all decisions, plans, and practices. Hence, the ethical concerns are quite important, especially when conducting interpretive research. Interpretive researchers, unlike positivists, tend to pursue the subjects in their social context to induce conclusions. Such procedures require deep engagement with participants and long-term research. Consequently, researchers need to ethically protect their research by protecting the participants' rights and avoiding any harm.

The core ethical concerns consist of accessing the researched context, gaining participants' consent, protecting personal identities and ensuring confidentiality, informing participants about their rights to withdraw, and notifying the relevant authority about any harmful or illegal actions that negatively influence the study's participants (BERA, 2004; Chon et al., 2005; Martens, 2010; Pring, 2004).

5.7.2.1 Consent forms and agreement

In order to access schools to conduct this research, an official step, which involves completing the agreement application for the education ministry in Kuwait, had to be followed. This step requires an examination of the research instruments and a clarification of the research aims and the study's purpose. Gaining access approval from the Ministry of Education can facilitate access to schools in the selected cases (see section 5.5 about the first practical procedure).

With respect to cases, science teachers were asked to sign the agreement sheet, which was handed out during the screening and case selection phase. This sheet contained information about the research aims, the participants' rights, and the practical plan of the fieldwork (see Appendix H). Candidates who agreed to participate and signed the consent form were asked to inform the researcher about their focused classes in order to send a research leaflet and consent forms to parents.

If participants are not adults, parents have to provide their consent by signing a formal consent to allow researchers to include their children in the study. Cohen et al. (2005) pointed out that although parental agreement is more difficult to obtain than the child's consent to participate, the researcher needs to obtain an approval that clarifies that the parent consented to the child's participation. Furthermore, the authors asserted that "children must be given a real and legitimate opportunity to say that they do not want to take part" (Cohen et al., 2005, p. 52).

Thus, consent to participate was achieved in two stages. Concerning parental agreement, the researcher acquired the agreement via the social workers in each school who serve as the central conduit between the school and parents. During this stage, the teachers informed the social workers in each school about the classes that were selected to participate in the study. The researcher then provided parental letters (see Appendix I) to social workers who forwarded the letters to parents. The social workers returned the signed forms to the researcher. In the second stage, the researcher introduced the study to the students and asked them whether they would like to participate in the study, thereby gaining verbal permission from the students as well. Consequently, the students as well as their parents had the right to say whether they wanted to be included in the study. Students with no parental agreements were not observed; hence, they did not participate in the focus groups.

5.7.2.2 Anonymity and confidentiality

According to Mertens (2010), researchers should protect the individual privacy of participants and exclude any identifying information from the research. In order to maintain participants' privacy, confidential information (e.g., students, teachers, and schools' names) mentioned during the interviews were not included in transcriptions or in any reports. Furthermore, pseudonyms were used instead of real names, giving nicknames to participants to ensure that all personal information supplied was kept strictly confidential. The researcher also reminded the participants of their rights and the researcher's role to protect them in different events. In addition, the schools' names were not mentioned in the study; instead, alphabet letters were used to refer to schools (School A, School B, School C, and School D).

5.7.2.3 Disclosure and feedback

Participants were informed through the consent forms about their rights, including the right to withdraw at any time and the right to maintain confidentiality, except in the case of potential harm to the child or participant. In this case, the researcher had to disclose this issue to the individuals concerned to avoid the threat to the participant. Another ethical dimension in the study was associated with participants' responsibility on the subject of disclosure. BERA (2004) encourages the process of informing participants of the research outcomes after the end of the study. Thus, the researcher asked participants to provide email addresses if they wanted to receive the results and informed of when the findings would be sent to them. The consent forms also contained the researcher's contact information, such as email address, mobile number, and email addresses of first and second supervisors, to enable the participants to request a report of the study findings.

5.8 Conclusion

To sum up, this chapter aimed to describe the methodological approach adopted in the study and address several methodological concerns. It sought to clarify the methodological decisions by justifying them, exploring their benefits, and acknowledging their limitations. The chapter started with a critical discussion of the meaning of the research paradigm, focusing on the differences among the major research paradigms to distinguish and justify the assumptions of the interpretive paradigm adopted in this study. It then introduced the sociocultural framework as a branch of the constructivist worldview.

The multiple case studies strategy was discussed as a research design followed by a discussion of sampling and case selection criteria. The applied methods were discussed and justified by addressing their benefits for the current study and by addressing the benefits of applying multiple methods to delimitate each method’s limitations. Practical research procedures were discussed as well, including accessibility, piloting, and main fieldwork. Both research methods and data analysis methods were discussed in detail. The last section, focused on trustworthiness and ethics, deliberating upon the quality and ethical issues.

The methodological approach must be justified carefully to demonstrate the appropriateness of the procedures to achieve the stated research purpose. Thus, the research built a relevant and coherent approach. However, this does not mean that the current methodology is free of limitations or is the ideal approach. Rather, this methodology was designed by taking into account fundamental aspects that need to be considered to generate good research methodology.

Chapter Six: Pedagogical Beliefs and Facilitating Factors (Thematic Findings)

6.1 Introduction

Chapters 6, 7, and 8 present the findings that emerged from the analysis of the raw data. Each chapter aims to answer specific research questions: Chapter 6 focuses on questions 1 and 2; Chapter 7 addresses questions 3 and 4; and Chapter 8 presents findings related to the last research question. Although some qualitative studies present their findings along with previous research findings from the literature to support the studies' findings; however, I would argue that this aim can be achieved within the discussion chapter, which expands the findings, draws further conclusions, and raises useful implications. Thus, these findings are presented without broad deliberations and discussions as Chapter 9 will focus on discussing and interpreting these findings.

The current chapter presents the results by exploring the pedagogical beliefs of science teachers with regard to fostering everyday creativity as well as the facilitating factors of these pedagogical approaches. The research questions that highlight these findings are: (1) What beliefs do science teachers hold about pedagogical approaches that foster creativity in science classroom? and (2) What are the sociocultural factors that facilitate these pedagogical approaches? In this thematic analysis, I have used the emergent categories and subcategories in presenting the findings instead of showing categories according to individual cases. This technique allows me to exemplify each theme with codes from all the teachers. Moreover, this chapter combines coded segments that are basically derived from teachers' interviews (i.e., Int.1 or Int.2) to explore their beliefs about teaching creativity and the facilitating factors. Thus, two major sections are created to demonstrate the findings for the questions related to pedagogical beliefs. The first section addresses the meaning of creativity and approaches for fostering creativity whereas later section discusses the second sub-question regarding the facilitating factors. Before presenting the findings, it is important here to provide an explanation of the codes I use in the presented quotations from various data resources (see Appendix. J).

6.2 Pedagogical beliefs of fostering everyday creativity (RQ1)

The section examines the pedagogical beliefs of eight science teachers. The categories and subcategories are classified under two major umbrellas related to the creativity and pedagogical approaches to foster creativity, as illustrated in Figure 9.

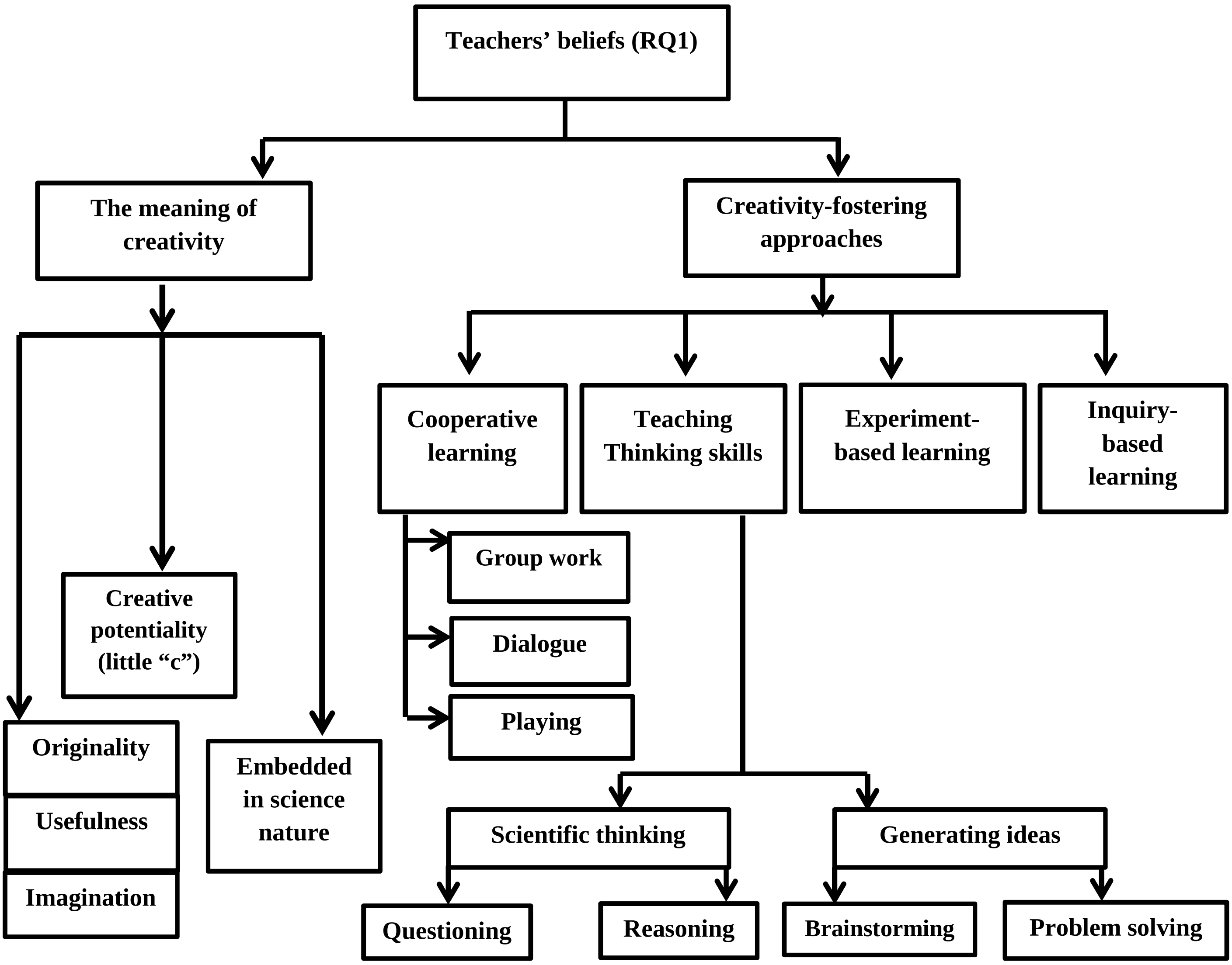


Figure 9 : Thematic map of science teachers' beliefs about fostering creativity

Overall, this thematic map is derived from the data analysis of teachers' interviews answering the first research question. The map demonstrates that science teachers identified four aspects to conceptualize creativity. In addition, they considered four major pedagogical approaches to be appropriate for fostering creativity. The findings of this map are displayed in this section.

6.2.1 Teachers' meanings of creativity

Three points are presented in this section. First, the findings revealed teachers' definition of creativity, in which they iterated three aspects to define creativity. Second, one theme represents the teachers' understanding of little "c" creativity, as six science teachers made a clear statement that everyone has the potential to perform creatively. Third, four teachers addressed the relationship between creativity and scientific nature, clearly stating that creativity is embedded in scientific nature.

6.2.1.1 Creativity aspects

The science teachers defined creativity by frequently addressing three aspects considered to be the chief components of creativity: originality, imagination, and usefulness. The three themes are different in terms of the frequent mentions (see Table 7). For example, originality is the most frequently mentioned theme when defining creativity. As the table indicates, 14 codes were components of originality. Originality was mentioned by all teachers; meanwhile, usefulness and imagination were mentioned by half of them.

Table7. Aspects of creativity

Themes	Theme identification	N of teachers	N of codes	Descriptors and indicators
Originality	Students come up with a new idea, process, or product to them.	(8)	(14)	New/unusual/different/original/extraordinary
Usefulness	Idea, process, or product should have positive and beneficial effects.	(4)	(8)	Useful/moral/positive/ beneficial to the community
Imagination	Creativity consists of an imaginative process to reach an original outcome	(4)	(11)	Imaginary/fantasy/imagination/ imaginative thing

6.2.1.1.1 Originality

The teachers strongly indicated that newness or originality is a fundamental element of defining creativity. All teachers shared this idea. They tended to define creativity as something that is different, new, extraordinary, and unusual. As Zayed explained, “creativity is extraordinariness. It means doing an unusual thing, something that is extraordinary, unlike the familiarity that surrounds you. It’s a pattern that is different from the existing patterns” (Z, Int. 1).

Zayed’s statement focuses on creativity in general. However, most teachers tried to describe creativity with regard to the educational context. As Fahed stated, “oh, creativity is anything new that the student invents, where it is not found in the school’s curriculum and is not known to the rest of the fellow students. It is brand new” (F, Int. 1). Such a definition adds a much clearer standard for describing students’ creativity, in which originality can be identified according to the degree of unfamiliarity of peers’ performance.

6.2.1.1.2 Usefulness

Four of the eight teachers did not find that newness is a sufficient aspect to define creativity; they believed that usefulness should be integrated with originality. Thus, as Ali commented,

> Creativity is something extraordinary. This extraordinary thing should have a positive influence. … I believe in moral notions; therefore, I must have positive creativity, not negative. The first element of creativity is being extraordinary, which means originality, and the second element is being useful, which means being beneficial to humanity. For me, creativity occurs when these two elements simply come together. (A, Int. 1)

Salem expressed similar sentiments when he clearly confirmed the role of usefulness in defining creativity. He acknowledged that the word “creativity” might have different or multiple meanings. However, he said that “creativity in general is the generation of a new thing or the development of an old idea by evolving it and making it more appealing to others. Thus, it becomes useful for society and for its development” (S, Int. 1).

Moreover, two teachers (Fahed and Ali) tried to offer examples of how to define a student’s response or performance as a creative one according to these two aspects. As Fahed mentioned, "it is anything novel and beneficial. For instance, creating an alternative and useful experiment is one kind of creativity. When the teacher conducts an experiment and then a student suggests that he has another experiment that shows the same results in a faster method, this is one kind of creativity" (F, Int. 1). Fahed exemplified student creativity by conducting an alternative and faster application. "Alternative" refers to a new experiment whereas "faster" refers to the usefulness because it can save the time.

Similarly, Ali said,

> I think if I taught a student a lesson, and then the student came up with a new useful idea with regard to the lesson or suggested a new and useful application of the lesson that might be different from what I taught, then this student is creative. This is because he covered the two elements of creativity, which are originality, meaning something new and a useful meaning of benefit to society. (A, Int. 1)

Overall, creativity appears to be perceived through such aspects. Most of the teachers considered creativity as a new "thing" that could be a process, an idea, or an object. Some of the teachers were aware that being original is inadequate, being original should be combined with moral consideration in which creativity is something good, useful, and beneficial. Other teachers indicated a third aspect of creativity; they strongly argued that the imagination is penetrated through creativity.

6.2.1.1.3 Imagination

Zayed, Mohammed, Ali, and Salem expressed that imagination is as important as originality and usefulness. For example, Zayed talked about student imagination as a fundamental indicator of creative actions; a creative student "has a broad imagination, asking questions with imaginative depth, where these questions were not asked before" (Z, Int. 1). Correspondingly, Ali clearly stated that "imagination is a creative ability. For instance, when a student uses his imagination and comes up with an unrealistic imaginary answer, this allows the teacher to discover the student's ability in implying the lesson and the extent of his imagination abilities" (A, Int. 1).

Another teacher emphasized the significance of imagination in forming a creative outcome. Mohammad insisted that coming up with something original cannot be attained without imagination; otherwise, this thing would be considered ordinary. He confirmed that "creativity is attached to the person's ability to imagine. … because, when the student imagines, his thoughts are turning to the extraordinary, moving towards generating something different and new" (M, Int. 1).

Furthermore, Ali not only stated his beliefs about imagination, but also gave a real example from his professional experience to clarify students' imagination as a chief aspect of creativity. He explained that, while he was teaching 11-year-old students about the expansion of solid matter, a "troublemaker" was not convinced about the idea of expansion, so he posed a question which Ali perceived to be a creative question.

> [The student] tested the experiment in his mind and decided to joke about it saying, "If the car expands in heat, it becomes a tank. Therefore, if your words are true, then the car increases in size and becomes a tank as an example." This student used his imagination ability in a practical sense and used logical thinking as well. If all solid matter expanded in heat and the car as a solid matter was to expand as well, then this student's thoughts are logical and creative. He imagined a situation and reached a conclusion that I had not discussed yet, which is that expansion is relativity and not whole. With his imagination, the student was able to come to this conclusion. (A, Int. 1)

Thus, imagination appeared to be an indispensable aspect for any creative endeavour. The data analysis revealed three aspects to define creativity; the findings also revealed that any person can be creative. In other words, these three aspects are not limited to a few people who have specific characteristics and traits; rather, all seven teachers believed that all of us have the potential to be creative.

6.2.1.2 Creative potential

The data analysis indicated that teachers shared a common belief about creative students as seven science teachers stated that creativity is for all. In other words, anyone has creative potential and is a candidate to be creative in the science classroom. Some teachers referred to multiple intelligence theory to justify their beliefs. However, other teachers bonded the concept of excellence with creativity, but they also made the distinction between the two concepts.

For example, Ali disagreed with the idea that all higher achievers are creative. He believed that being excellent or a high achiever could be indicator, but is not a criterion.

> It is not always true that an excelling student is creative while students with lower grades are not creative. Grades cannot be used as a standard to measure creativity, but they could be a good indicator. … The first thing we notice are the high grades; however this is not a 100% accurate criterion, just an indicator (A, Int. 1).

On the other hand, four teachers held a much clearer position regarding the creative potential of students. They justified that individuals have multiple abilities and desires; therefore, they can be creative in particular circumstances and non-creative in others. One case in point is Mohammed, who believed that a creative student in math is not necessarily creative in other areas.

> Creativity can come from any person. This means that humans have varying abilities that are different in one area than in another for the same person. A student who is creative in math is not necessarily creative in other areas. What I am trying to say is that everyone can be creative in science but at different levels that vary among the students. (M, Int. 1)

Furthermore, Zayed referred to multiple intelligences. He believed that being creative in one unit of science curriculum does not mean that the individual will be creative in other units. He justified this belief by referring to the multiple units of science, such as physics, chemistry, biology, and geology.

> According to the multiple intelligences theory, some individuals have a specific intelligence, for instance in music, and others have kinaesthetic intelligence and so on. The science subject is comprehensive and includes physics, chemistry, biology, and geology. We can find students who are creative in one branch of science, whereas other students are creative in all branches. Creativity differs depending on the subject and depending on the person's interest. (Z, Int. 1).

6.2.1.3 Creativity and science nature

Teachers' beliefs with respect to the relationship between the nature of science and creativity were revealed during the teachers' interviews. None of the teachers claimed that creativity cannot be fostered in science fields; rather, all of them claimed that "the science field is full of creativeness" (M, Int. 2). However, such a claim does not explain the relationship between the nature of science and creativity. Therefore, only four teachers made a clear connection and believed that creativity is a part of the nature of science.

According to Khalid, "creativity is a form of thinking", and "…science needs such a form of thinking" (K, Int. 2). Fahed believed that science is not only a matter of facts; rather, it also stands on an individual's perspective, imagination, and thinking. He stated that "it could be true that science is made of facts; however, individual thinking is an important aspect of science" (F, Int. 1). He added that the person engaged in science needs to "imagine, think, interpret, and then reconstruct the phenomenon according to [his/her] individual perspective" (F, Int. 1). Such a statement indicated that the nature of science is not totally an objective matter; rather it is based on the subjective base, where science cannot be value-free. In addition, an individual's imagination and creativity are embedded in the process of constructing scientific knowledge. As Ali stated, creativity is an accompanying aspect during the construction of scientific knowledge; thus, it is an indispensable aspect of the nature of science. Ali said:

> Creativity in science differs from creativity in other fields. … Creativity in science is more … related compared to creativity in other subjects. I mean, creativity can emerge during the process of generating ideas and thinking about them, the process of implementing these ideas and doing practical tests and the process of analysing the results. There are many steps or implications in doing science that require creativeness. (A, Int. 1)

Hence, half of the teachers connected creativity with the nature of science, through which creativity is a major aspect to "construct scientific conclusions and understand scientific phenomena" (S, Int. 1).

To sum up the meaning of creativity, all teachers found that originality is a fundamental aspect of creativity; in addition, four out of eight teachers added that originality should be combined with usefulness. Their point is that creativity should have a positive outcome and be valued by society. In addition, half of the teachers referred to imagination as the third aspect related to doing something creative. Therefore, creativity appeared to be something original, useful, and imaginative. The teachers also referred to creativity as a process, a person, a product, or a context, which are the elements of creativity. The teachers' references to these elements indicate that they were aware that creativity requires different elements in order to emerge. Furthermore, seven out of eight teachers indicated that all students have the potential to be creative; only one teacher claimed that creativity is limited to a few students with specific traits. This indicates that the teachers believed in everyday creativity or the model of little "c" creativity. Furthermore, four teachers made a clear connection between creativity and the nature of science, perceiving it as a fundamental aspect of scientific nature. These findings will be deeply discussed in Chapter 8; meanwhile, the next section demonstrates the findings of the pedagogical approaches believed to be used as methods for fostering creativity in science class.

6.2.2 Creativity-fostering approaches in the science classroom

Science teachers' beliefs revealed 9 pedagogical themes that are seen as appropriate for fostering students' creativity. The themes are categorized under four key umbrellas: cooperative learning, teaching thinking skills, inquiry-based learning, and experiment-based learning. Hence, the next subsections present these findings in-depth and illustrate the themes of each approach.

6.2.2.1 Cooperative learning

The cooperative approaches are based on dialogues and interactions that occur between the teacher and the students or among the students themselves. The teachers held positive beliefs about working together, sharing thoughts and ideas, and role playing to be significant pedagogical activities to foster creativity in the science classroom. Science teachers offered sufficient statements to represent their beliefs of teaching through cooperation, such as group work, scientific dialogues, and playing (see Table 8).

Table 8. Overall findings of fostering creativity through cooperation

Sub-themes	Definition	N of teachers	N of codes	Overall findings
Group work (teamwork)	The process of working collaboratively with a group of students in order to achieve a specific goal	7	19	*Group work activities promote creative interactions among students. *It develops different individual skills that in return develop creative skills, such as communicative skills, leadership skills, decision-making skills, listening skills, and discussion-leading skills. *It facilitates more comfortable space for students to share their original ideas with peers.
Scientific dialogues	Conversation about scientific topics between two or more to solve a problem, resolve a question, or make a decision	7	26	*Discussion encourages students to generate and share their creative ideas. *Discussion and dialogs are student-centred activities that work against indoctrination and teacher-centred activities. *It also contributes to building up a creative personality.
Playing	Cooperative learning activities that are considered to be funny and enjoyable for students	4	7	*Games, role-playing, and skits are enjoyable and entertaining activities that foster students' imagination and participation within classroom activities.

6.2.2.1.1 Group work (teamwork)

Most of the teachers confirmed that they believe in cooperative learning as a teaching method for fostering creativity. Zayed noted that cooperation among students can lead to creative interactions in which the students are more able to create class activities by themselves. He said that “group work means that, when you teach a subject …, you can distribute the tools of the experiment for each group, and then the students start conducting the experiment together, reasoning the ideas, finding laws, and eventually figuring out the whole topic. They themselves build up the lesson” (Z, Int. 1).

In addition, a number of teachers focused on the role of group work because it might develop personal skills and increase individual effectiveness, which in return develops the creative endeavours of the students. For example, Fahed stated that “a cooperative group improves creative skills because it develops communication skills within the group. These skills can include leadership skills, listening skills, discussion-leading skills, decision-making skills, etc. This means that all of these skills are developed through group works” (F, Int. 1). Similarly, Ali bonded between fostering creativity and encouraging students’ cooperation; he declared that group work is a pedagogical practice that is considered to be “one of the methods of cooperative learning” (A, Int. 1). When asked to clarify the importance of such relationship, Ali believed that students are sometimes not keen to share their unusual ideas with him; however, he can easily observe these new ideas when it is shared among a group’s members.

> A creative individual can be distinguished within group discussions, when such individuals share opinions that are unlike the ordinary opinions. Thus, I can notice these individuals through their dialogues and thoughts. These students might not be able to communicate their thoughts to me, but they might be able to communicate it to the group. (A, Int. 1)

Omar and Khalid also called for adopting group work because it has “positive outcomes on students” (O, Int. 1). They reinforced this approach because it is student-centred and avoids the “dictation teaching style” (K, Int. 1). Overall, the data analysis indicated that teachers believed that group work can foster students’ creativity because it creates a space of comfort, cooperation, and participation. Teachers confirmed that students can easily share their new ideas, cooperatively refine their ideas, and effectively build up various skills that are needed for manifesting creative efforts.

6.2.2.1.2 Scientific dialogues

According to the science teachers, dialogue within the classroom is a pedagogical practice fostering creativity. The teachers thought that students' dialogues not only encourage the emergence of original ideas, but also enable students to think about and analyse these ideas. Some teachers (Omar, Khalid, and Ali) directly indicated that teaching science by establishing dialogue works against lecturing and dictating practices, instead creating opportunities for creative and interactive engagement.

As Omar said, this teaching practice allows new ideas to be generated within the class because it offers space to express and share ideas, unlike the teacher-centred practices; when he said that "the discussion of ideas is a method for enriching the class with new thoughts. The most important thing is that students are not dictated the information". Omar strongly maintained practices based on student-centred activities, such as dialogues because "students must not be like a cogwheel isolated from the machine; they must be a basic cogwheel in the machine" (O, Int. 1). Establishing dialogues has also gained Khalid's trust; he spoke strongly about avoiding the direct transmission of information and supporting students' participation. "The most important thing in the science subject is not to use speeches as methods of communication. … However, you have to let students take part and participate" (K, Int. 1).

According to Ali, dialogues enable his students to generate a large number of ideas and reason the most appropriate ones. Ali justified that, "if I allow a discussion in class, I would get various answers and ideas"; in addition, students can negotiate their ideas and reason out the most acceptable ones. "[Such dialogues] help the students think, deliberate, and reason more, and this is the main purpose of the lesson, which is to make the students reason the answer rather than receiving the direct answer" (A, Int. 1).

Hence, establishing scientific dialogues is widely supported by teachers. Such dialogues offer opportunities for students to interact creatively and build up their communicative skills. Another practice that appears to offer a similar opportunity is playing. Four teachers talked about playfulness as a form of cooperative learning that more likely supports students' creativity.

6.2.2.1.3 Playing

Playing is another cooperative practice that the four teachers consider to be appropriate for fostering creativity. The teachers believe that role-playing, games, and acting are effective and stimulating practices. According to Zayed, "you can present some of the thoughts and lessons to students by prompting entertainment and imagination. For example, you could propose a specific situation for the students to think of, or you could perform a drama skit that the students would think of and interact with" (Z, Int. 2).

Furthermore, Ali has a positive belief about funny acting scenes and playing. He shared his positive experience of applying acting scenes to teach the differences among gas, liquid, and solid substances. Ali stated that his students were very enthusiastic to participate, which in return encouraged them to search, read, and prepare themselves to be chosen for the play.

> [The students] had to know their own roles and the roles of others in order to act. The role itself is a topic; thus, the students learnt the lesson by imagining and memorizing their own roles and the roles of others in the play. Thus, I delivered the lesson through students' involvement in a funny play in class. (A, Int. 2)

On the other hand, Fahed indicated that applying games could be more beneficial for sixth-grade students than for students in other grades. He explained that playing "works well in sixth grade because students at this stage are in the late childhood stage, where the students still enjoy playing and still enjoy moving around. … There are many games that motivate the students to think" (F, Int. 2). He added that playful learning "allows the students to have fun, enjoy their time, use their imagination and be creative. … Also, it would help the students to like the subject more and they will study more for it" (F, Int. 2).

Cooperation, collective, and social engagement activities (e.g., work groups, dialogues, and playing) emerged from the data analysis. They appeared to encourage pedagogical practices regarding teaching creativity in the science classroom. Notwithstanding, the teachers did not focus only on cooperative learning practices; they also argued for the importance of teaching thinking skills to foster creativity, as discussed below.

6.2.2.2 Teaching thinking skills

The teachers revealed that teaching thinking skills and focusing on mental processes are one of the most effective teaching methods to foster students' creativity. The findings illustrated four themes related to teaching thinking skills that questioning, reasoning, problem solving, and brainstorming skills. The four themes are divided into two categories: questioning and reasoning represent the category of scientific thinking skills whereas problem solving and brainstorming represent the category of generating ideas skills.

6.2.2.2.1 Scientific thinking skills

Teachers indicated that they must develop certain thinking skills among their students to enable them to perform creatively inside the science classroom. Teachers made a connection between the skills of thinking scientifically and being creative in science. Therefore, "the student must be taught how to be creative and how to think scientifically" (F, Int. 1). Khalid pointed out that "creativity … in my opinion, is the ability to think. If the student was able to think in a scientific way, then he will be able to be creative. The most important thing is that you would make the student think" (K, Int. 1). The most common skills mentioned by the teachers were questioning and reasoning skills, as illustrated in Table 9.

Table 9. Teaching scientific thinking skills

Sub-themes	Definition	N of teachers	N of codes	Overall finding
Questioning	A thinking form in which a series of questions are addressed as intrapersonal reflection or interpersonal communication	(7)	(18)	Offering a space for students' questions fosters their creativity. Students imagine things, and they question themselves about it. Seven teachers believed in supporting students' questioning skills, because it would encourage them to imagine and think about new things and be more creative.
Reasoning	The process of thinking about something in a rational way in order to form a conclusion or judgment	(7)	(9)	Seven teachers believed that reasoning skills are significant to help students draw conclusions on their own. Reasoning could lead students to new things. Also they could scientifically justify their original thoughts through reasoning.

Questioning skills

Almost all of the teachers believed that encouraging students' questioning is more likely to lead to original questions and conclusions. They also believed it to be a great opportunity to distinguish creative students in their classes. Questioning is the most coded theme compared to other thinking skills. Some teachers provided more than one example of students' questioning. As a result, a consensus about questioning existed among science teachers.

Salem said that "encouraging questioning is important because it opens an opportunity for the students to participate and to think of new things" (S, Int. 1). One teacher, for example, connected posing questions and individual imagination; he commented that students come up with extraordinary questions when they use their imagination: "The creative student applies his imagination on reality, thereby asking strange questions that have creative depth. … When the teacher thinks about what the student is asking, the teacher will realize the creativeness of such questions" (A, Int. 1). Another teacher provided an example from his schooling experience about a student who asks deep questions:

> One time, a student approached me and asked why, when he swims in the sea or in a pool, the skin of his palms shrinks and sometimes peels off. When this question was asked, I felt that I was in trouble, because the question was not expected and … required me to do some research. It was an embarrassing situation; however, my colleagues and I sat down and discussed it and then did some searching over the internet to find an explanation for this phenomenon. (S, Int. 1)

Similarly, Khalid recalled a real example of a student's questions from when he was teaching students about nuclear energy.

> One student had asked many and unexpected questions; [his] questions were about nuclear reactors and how they work. He asked how it is possible to keep the reactors at a particular height and how nuclear reactors can be controlled; meanwhile nuclear bombs cannot be controlled, especially once the nuclear reactions start in a nuclear bomb, [and he asked] why we cannot stop them. Impossibly, the nuclear reactor has a similar concept as the nuclear bomb, but they are different. … So this student asked about how this is done and how is the temperature controlled when it has the ability to reach a million degrees in the centre of the explosion. (K, Int. 1)

Khalid believed that creativity can emerge through this sort questioning, which is beyond students' chronological age. "Such questions would usually be brought up by secondary school students and not by intermediate students" (K, Int. 1). Thus, Zayed argued that science teachers "can notice creativity from questions that children ask", as the type of the asked questions "indicates if the student is thinking about something new or not" (Z, Int. 1).

Reasoning skills

Reasoning is also frequently mentioned by the teachers. They believed that reasoning is one of the major skills that scientific thinking stands on. For example, Ali said that reasoning is always addressed in science teachers' lesson plans because conclusions should be drawn at the end of each lesson. He strongly believed that students' reasoning leads them to discover conclusions on their own. He justified his belief by saying "reasoning and drawing conclusions are tools in science subjects that help students create their own interpretations because it allows students to discover and to reason using the facts that are provided" (A, Int. 2).

Zayed emphasized that the students can be creative and can create a whole lesson if the teacher encouraging them to use their reasoning skill. He believed that creativity can be fostered when that teacher provides space for students "to reason out ideas and laws … and figure out the whole topic" (Z, Int. 1). Similarly, Omar focused on reasoning as process that should be done by students themselves: "The science subject has many activities. I attempt to do these activities in groups or at least I demonstrate the activity for the class; however, deductive reasoning must be drawn by the students themselves" (O, Int. 1). Moreover, Mohammed considered the process of reasoning as a scientific phenomenon that is a sort of creative performance. He clarified his point by example and said:

> For instance, let's assume I conducted a simple experiment such as the process of water evaporation and condensation and the formation of dew. How did all these processes occur? The students must draw the conclusions through reasoning. Students' reasoning implies connecting the facts, analysing, interpreting, and explaining the whole process of the water circle. Then, reaching and drawing conclusions that students thought of are creative efforts (M, Int. 1).

Overall, the teachers called on the need to support scientific thinking skills, especially, questioning and reasoning. They believed that such skills are more likely to lead to creative outcomes and enable the students to draw original conclusions on their own. A few teachers added other thinking skills, such as problem solving and brainstorming skills, which aim to generate ideas.

6.2.2.2.4 Skills for generating ideas

Generating ideas or "getting ideas" as stated by Cropley (2001, p. 138) refers to the systematic process of producing and evaluating ideas such as problem solving and brainstorming. These methods were addressed by only three teachers; only 5 codes represented problem solving and 7 codes represented brainstorming, providing weak support for these themes compared with the number of codes supporting other thinking approaches.

Nevertheless, the few codes consist of confirmations and assertions that demonstrate the strong beliefs held by these teachers. For example, Salem asserted that "one of the approaches that helps in developing one's creative skills is problem solving. In problem solving, the student determines the need or the problem, and then attempts to find a solution" (S, Int. 1). Zayed also found that problem solving encourages the student to generate ideas and find solutions; he is convinced that it motivates his students to be creative. He confirmed that "[teachers] must use the problem solving technique; it has great effects [such as] asking problem questions, discussing issues, and encouraging the students to participate as they would want to take part in solving the problem and coming up with new ideas" (Z, Int. 1).

Similarly, Ali talked about problem solving as a way to foster students' fluency in finding numerous solutions to solve one problem, which in turn makes the students depend on their imaginations. He believed that:

> Problem solving is another point regarding this; a creative person can come up with multiple ways to solve a problem, which means he will not depend on one method but more than one to solve the problem. For instance, the student asks in class, "All right, can I do so and so?" and "If I do so and so, what will happen?" Thus, this is showing that the student has a broad imagination. (A, Int. 1)

Zayed and Ali not only addressed fostering problem solving skills, but also believed in brainstorming to foster creative ideas. As Zayed said,

> Brainstorming helps students generate new ideas. The student might not participate at the beginning, but then he might start liking an idea that was suggested by one of his friends who already participated, which in turn gives him a push of encouragement to share his thoughts. Then, you will find that new ideas are being generated … and that you yourself as a teacher and as a specialist in the lesson subject have never thought of such ideas. (Z, Int. 1)

In this regard, Ali stated that adopting a strategy for producing ideas, such as brainstorming, leads to creativity. He believed that “the more there are generated thoughts, the better it becomes. This means more fluency and flexibility are achieved in the students’ thoughts” (A, Int. 1). He claimed that teachers can use brainstorming to generate original ideas among students, which is one of the principles of creativity. For instance, when brainstorming is applied, “the student can convert the facts that he learned into new ideas; this indicates his creativity and his understanding of the lesson” (A, Int. 1). Jasser marginally mentioned brainstorming when he adopted it as practical example to generate ideas for everyday life: “Some ideas come from the student’s real life. You can give them a practical example from their daily life, where it is preferred to adopt discussion methods or brainstorming when doing so” (J, Int. 1).

Overall, teaching these four thinking skills appeared to be appropriate according to the informants. The teachers also mentioned the inquiry-based learning approach. All the teachers agreed that, for the sake of creativity in science topics, students should be independent and investigate and research issues on their own. Teachers held very optimistic beliefs regarding inquiry-based learning, as demonstrated in the next subsection.

6.2.2.3 Inquiry-based learning

Most of the teachers focused on conducting guided and open inquiries, which all of the science teachers frequently mentioned. They believed that creativity depends not only on the teacher’s applications, but also on the students’ efforts and endeavours. Some teachers believed that the teacher should direct his students and encourage them to develop their personal development on their own to become creative in science, which refers to guided inquiry practice. Meanwhile, others spoke about open inquiry, where their students should establish their own investigation about a specific problem they noticed, not their teachers. The teachers were keen on student independence; they pointed out that making the student dependent on others will not lead to creativity. They believed that inquiry-based learning would make the student more independent and promote self-learning under the science teachers' supervision.

> One of the effective and fast methods is conducting inquiry and writing scientific reports. The investigating process is very important for developing creativity. The problem is when information is delivered to the student without any effort or hard work. … This would first cause laziness and dependence on others, which in turn … hinders individuals from being creative. (S, Int. 2)

Salem argued for encouraging students' inquiries because, if such an approach is frequently applied, it will be a long-lasting practice that enables the students to do scientific inquiries when they need to investigate scientific issues.

> Conducting inquiries helps in memorizing the information because this information was obtained after a long process of searching and reading. After repeating this practice a number of times, conducting inquiries becomes a permanent behaviour of students, and becomes a mode for the students to find answers for their questions and thoughts (S, Int. 2).

Fahed believed that the teacher's role is to leave the students to learn by themselves, with some direction, by which he can motivate the students to be independent in their learning journey. According to Fahed, students' questions should not be directly answered; rather, these questions should be a subject for guided research. For example, if a student asked an unexpected question, the teacher can say "I will pose that same question tomorrow, expecting all students to do a search and participate with their opinions and answers" (F, Int. 1). The target of this practice is to motivate students to do some research.

> This means that you are at least motivating the students to think about the question as they return home. You are motivating them to think about the question, even the student who asked the question will learn on his own the next time. He might not approach you and ask; rather, he might go directly to search for answers and then share with you the conclusions of his investigation. (F, Int. 1)

Fahed also spoke about open inquiry, and indicated that such an approach could lead the students to original findings. When asked to show evidence of open inquiry outcomes, he referred to a 12-year-old student who was seen as a creative student in science.

> Once, one of my students approached me and told me that he discovered a treatment for a specific disease. I listened to what he had to say. Of course he had some wrong information, but I felt that he was searching for something, he was thinking about it, and his thoughts were amazing…. He did not ask if you want to listen to me or not; rather he said "I discovered something" and had already taken pictures and written his thoughts down. This was considered an unusual effort by this student. (F, Int. 1)

Overall, inquiry-based learning gained the trust of all the teachers; they repeatedly mentioned it and called for applying it. Similarly, most of the teachers concluded that creativity can appear when students conduct practical experiments. The informants believed that their students can creatively perform by conducting experiments and doing lab activities.

6.2.2.4 Experiment-based learning (practical investigation)

Seven teachers mentioned practical experiments. They believed that doing practical experiments is fundamental practice in science subject. Some teachers stated that such a practice could facilitate the creation of new and alternative practices to reach specific conclusions. Others believed that the advantage of conducting experiments develops different skills that are needed to demonstrate creative performance, such as thinking, investigative, and psychomotor skills.

For example, one teacher stated that science depends on experiments: "[Teachers] have to integrate lab experiments into classes because it is a pedagogical method that allows the students to experiment and discover on their own. This method of discovery through experiments allows the students to think of new applications to conduct the experiment" (A, Int. 1). He believed that it is proper practice for discovering and drawing new conclusions. Ali reported more than once that students' creativity can be fostered by allowing them to practically test and investigate. He exemplified his point by saying that "I can offer tools and materials for an experiment or a specific activity for each student or each group. I show them an example of conducting the experiment, and then I ask them to conduct it in a different way" (A, Int. 1).

This belief is also held by Fahed, who asserted that science teachers can motivate their students by explaining the theoretical part of the lesson, then asking them to figure out the practical applications. Such pedagogical practice “is a challenging activity, where students need to think of practical examples. For instance, [the teacher] can explain a theoretical topic without conducting an experiment. After that, [the teacher] leaves their students to conduct a practical experiment and to discover on their own how to conduct it” (F, Int. 1).

Students can share their ideas, test their possibilities, and find solutions when they are doing practical experiments. Therefore, some teachers assumed that it is one of the best teaching practices because it allows the students to “practically discover new things and answer ‘what if’ or ‘what will happen if’ questions” (O, Int. 1). Jasser also stated a similar point, saying “before allowing the students to experiment with a specific topic, the teacher can ask them about their predictions about what will happen. This will evoke them to think and offer unexpected possibilities and thoughts. … After that, they can test and compare their thoughts with the outcomes of their practical activity” (J, Int. 1). Another teacher supported this view, confirming that “teaching through experimentation or by performing individual activities means that I provide an opportunity for the student to depend on himself in finding the solutions and answers” (S, Int. 1). Thus, most of the teachers believed that allowing their students to apply practical experiments could lead to creative actions inside the laboratory; students can then imagine possible conclusions and test these possibilities via experimentations.

6.3 Facilitating factors (RQ2)

In the previous section, the findings revealed teachers’ pedagogical beliefs, indicating four major approaches considered to be appropriate for fostering students’ creativity in science classrooms. In this section, the findings answer the second research question: What are the sociocultural factors that facilitate these pedagogical approaches? This section aims to address the finding of sociocultural factors that support the previous pedagogical approaches mentioned by science teachers. The data analysis demonstrated that science teachers did not simply believe that the major approaches can foster students’ creativity; rather, teachers were keen to address factors that play a role in terms of “teaching for creativity”. Thus, multiple facilitating factors emerged and were categorized under three interdependent categories (see Figure 10).

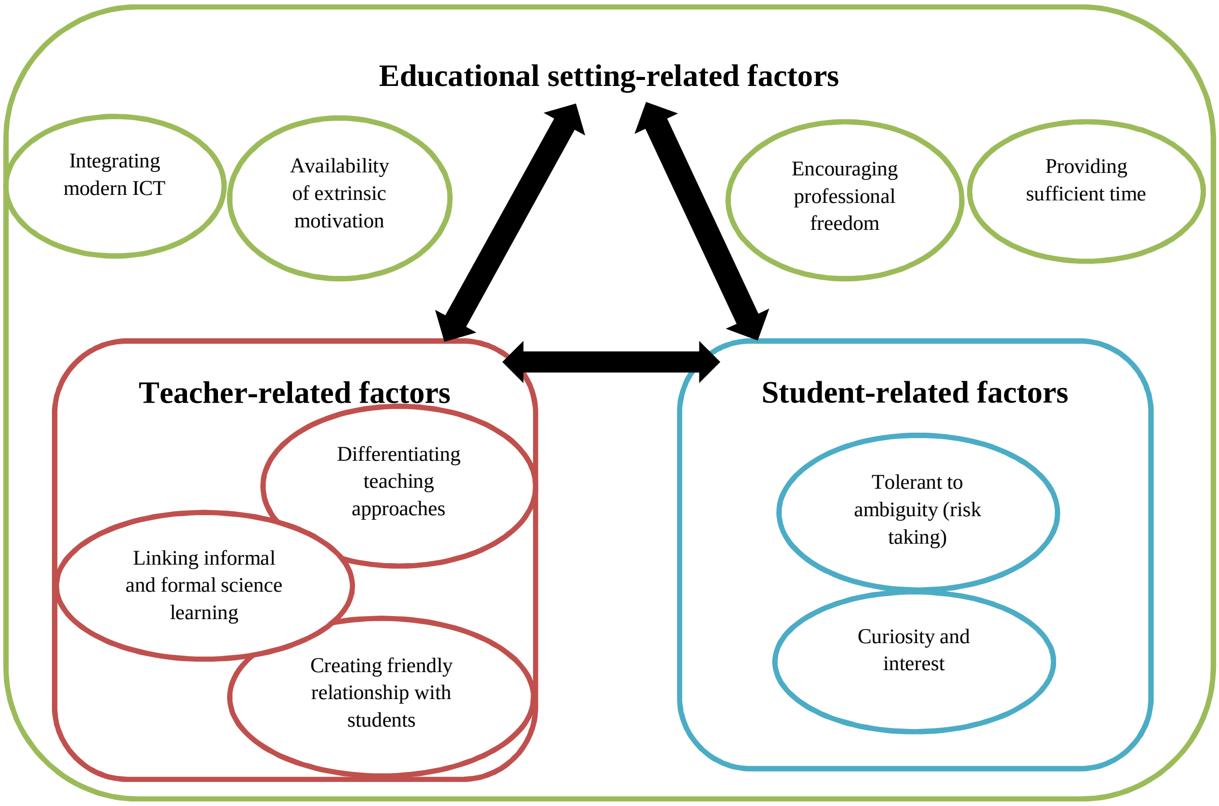


Figure 10: Thematic findings of facilitating factors of fostering creativity

6.3.1 Educational setting-related factors

The educational setting is managed by the Kuwaiti centralized system which has the authority and controls the educational policies, aims, assessments, and plans. Basically, it refers to the policymakers in the Ministry of Education, educational districts, and even school management. Science teachers pointed out four themes related to the educational setting in which they interact: encouraging personal freedom, providing sufficient time, making extrinsic motivation available, and integrating ICT.

6.3.1.1 Encouraging professional freedom

All the teachers mentioned that freedom is strongly connected to fostering creativity and performing creatively. They agreed that freedom is needed for both teachers, in the sense of dealing with the science curriculum, and for students, in the sense of having space for expressing, sharing, and conducting their own ideas.

With respect to student freedom, the findings indicated that it is a chief condition for students' creativity. For example, Zayed believed that students need freedom to do what they like, not what the educational system likes. He stated that "a student should feel free to choose what he loves. At the end the students will make the choice, but [teachers] need you to give them the freedom to do so" (Z, Int. 2). Encouraging proffesional freedom enables the students to make choices on their own. For example, Omar pointed out that in order to see creativity inside the classroom, three elements should exist: enthusiastic students, availability of resources, and freedom. He added that "if I ask the student to conduct a specific experiment with specified principles and specific information, this is not creativity, because creativity requires freedom" (O, Int. 1). One teacher claimed that any pedagogical practice that offers a free space for students could foster their creativity. Salem proclaimed that "any method which offers freedom for the students and for the teacher develops creativity. This means giving the students the freedom to ask and to try on their own, which will develop higher thinking abilities, including creative thinking skills" (S, Int. 1).

In regard to teacher freedom, a number of teachers also referred to flexibility and freedom in terms of managing the science curriculum. One teacher declared that "freedom … is to give freedom so that others would be creative without any constraints" (O, Int. 1). Omar confronted the constrained educational policies and regulations and felt that it is hard to see creative action where teachers' freedom is not promoted. Therefore, he concluded that "freedom must be allowed for the teachers in the first place, and then for students to be creative" (O, Int. 1).

Omar's statement suggests that teacher's freedom is a priority and should be offered so that they can offer it to students. Ali and Zayed also acknowledged that teacher freedom is one of the most significant requirements for fostering creativity. Ali pointed out that science teachers should be "flexible when it comes to following the curriculum and be flexible in evaluating students' performance in exams because creativity needs this sort of space. Hence, teachers' freedom is extremely wanted” (A, Int. 2). Zayed similarly acknowledged this, saying that “allowing and encouraging teachers’ freedom are necessary when it comes to working with the curriculum… and evaluation system” (Z, Int. 2).

Overall, the teachers focused on their freedom and not being limited by constraints created by the educational system. Such a degree of freedom helps them to be flexible within the science classroom and encourage their students’ autonomy as well. Therefore, the data suggest that students’ freedom and teachers’ freedom are interrelated; this relationship can be clarified by an old Arabic say that Ali mentioned when talking about encouraging professional freedom: “You cannot give what you don’t have” (A, Int. 1).

6.3.1.2 Providing sufficient time

All teachers agreed that fostering creativity requires a flexible period of time. They commented that providing a plenty of time enables them to foster creativity, so some of the informants talked about either increasing the duration of the class or decreasing the curriculum load. According to Fahed, “sufficient time is something indispensable. Of course creativity requires time. The duration of classes must be increased to longer than what they are now” (F, Int. 1). He justified that by saying “you must provide the students with enough time to think creatively” (F, Int. 1). Another teacher also mentioned the need to increase the class duration. He believed that creativity needs multiple kinds of activities and participations; having sufficient time for these classroom activities is essential. “We have to increase the class duration [in order to] include various activities” (Z, Int. 1). Ali pointed out that fostering creativity is not limited to indoor activities, so time plays a major role.

> Education with the goal of fostering creativity is not limited by schooling; we have to expand, discover, and experiment. These activities require a lot of time, and require fewer lessons or less information. If I can decrease the amount of information stated in the textbook, then I would have more time. The extra time will allow me to conduct different activities with my students. (A, Int. 2)

Khalid criticized the current duration of time and was unconvinced that the current time helps him foster students’ creativity while also meeting the curriculum plan. “For the sake of fostering my students' creativity in science, I would have to spend more time with them. You cannot convince me that I can complete the lesson and foster their creativity in this short time" (K, Int. 2).

6.3.1.3 Making extrinsic motivation available

Four teachers believed that encouragement is required for both students and teachers. It appeared that teachers can only encourage students through verbal rewards, which seems insufficient for guaranteeing students' continuous creative performance. Fahed stated:

> It is necessary to appreciate students who discover new things and conduct research as an individual effort. The educational system should also acknowledge teachers. A teacher who has effective teaching abilities and helps develop the creative abilities of his students must be encouraged so that he would continue doing what he is doing. (F, Int. 1)

Fahed is convinced that teachers should be rewarded and stimulated to continue fostering students' creativity; he also believed that students need to be socially appreciated to reinforce their creative interactions. Similarly, Salem said that "using verbal and non-verbal [tangible] motivations are very important; hence, schools should do so not only with creative students, but also show appreciation for their teachers" (S, Int. 2). Salem believed that he can verbally motivate his students and inspire them to keep doing their tasks. However, he acknowledged that, for students to be creative, they need more than verbal encouragement. They also need tools and equipment to conduct their ideas.

> When the student has interest in a particular topic I should encourage him, respect and discuss his ideas and thoughts. This is a verbal encouragement. As for the non-verbal [tangible], the school must provide the instruments and the tools that are needed for the student to implement his ideas, and it should reward him. (S, Int. 2)

Another teacher believed that teachers' words and verbal motivation is not enough. He spoke strongly about the school's rewards and said that "for instance, a student acted in a play in the school or made paintings; school has to reward him because he was creative. Encouraging him verbally is insufficient; students must be encouraged by giving them prizes and certificates" (O, Int. 1).

Yet Zayed shared a different view than Omar with respect to verbal motivation. He believed that verbal motivation is the most effective way due to the students' age. For example, he said that "verbal motivation for the student is an important factor. Some students need verbal motivation, especially teenagers. This means that when you verbally motivate the student, he would feel the need to present the best of what he has in the next class" (Z, Int. 2). Meanwhile, he considered gifts and prizes to also an effect on students: "You can motivate them for instance by presenting monetary prizes in contests. They should, of course, be nominal prizes or gifts" (Z, Int. 2).

6.3.1.4 Integrating ICT

All the teachers talked about integrating technology into science classrooms and how it can foster students' creativity in the science classroom. Generally, teachers perceived applying technology as an important factor for achieving three aims: 1) enhancing students' personal development; 2) attracting and grasping students' attention and interest inside the classroom; and 3) enhancing the quality of delivering the lessons.

With respect to personal development, some teachers felt that using ICT plays an indispensable role in personal development. For example, Mohammed affirmed that "we cannot ignore the role of the internet and the modern devices in obtaining information. We don't search for information at the library anymore! Rather we check the internet and the modern devices that are in the pockets of the students" (M, Int. 1). Mohammed argued for applying ICT inside the classroom because such technological devices contribute considerably to "developing students' skills" and have become the first resource of students' learning when they are outside the school. "The daily use of modern technologies in our society, such as the internet, computer, and iPad, plays many roles in developing the life of individuals. So I think encouraging students to use technology in the class will facilitate their learning outside the school as well" (M, Int. 1). Both Mohammed and Ali believed that ICT has penetrated the Kuwaiti society in which students live; it is connected with their everyday lives. Therefore, adopting technology in students' learning could help them be creative on a daily basis.

> The evolution of technology helps in motivating creativity. The information revolution and the internet have become great tools and have provided an electronic library inside every house. This helps in developing students' creativity. For instance, it provides enough information through which you can become creative in your life, and thus change your life. Information is now available everywhere. (A, Int. 1)

Other teachers (Salem, Jasser, Zayed, and Fahed) mentioned that their students are very knowledgeable of technological issues and use technology every day. They believed that ICT is very attractive for the students, and when they apply it in their classes, the students creatively interact and participate in the classroom activities. For instance, Salem acknowledged that he integrates ICT in his classes due to students' interests in using technology.

> I love using technology in teaching for various reasons. Most of the students have great experiences using technology. Currently, every student has an account on Twitter, Facebook, Hotmail, Instagram, and others. Even with games, they have accounts with PlayStation, X-Box, etc. For this reason, the students usually tend to become bored with the traditional methods of teaching which do not harmonize with the nature of this generation, especially teenagers. (S, Int. 2)

Integrating ICT could make school a more competitive environment compared to students' social lives. Jasser justified that "when the students see the technology at the school that is similar to the technology that they have at home, it gives them a sense that the school is not far behind in technology. Thus, they become interested even more" (J, Int. 1).

Furthermore, Salem, Omar, and Fahed indicated that some topics are limited when using the lecturing style, but when they integrate ICT as assisting tool, they can vary the pedagogical activities and increase the quality when delivering the lessons' information. Both Omar and Fahed shared examples of how ICT has assisted them in increasing the quality of delivering lessons.

> For instance, if I am teaching a lesson about the structure of the chromosome, no matter how good I am at drawing it for them and explaining the structure and the

> genetic map formation, my drawings and explanations will never be at the same level as presenting a scientific video through a data show. (O, Int. 1)

> When you want to show the atom, and you want to show the angles between the atoms or the molecules; you can clearly draw and show angles of 90 degrees or 80 degrees, or you can show it in videos using three dimensional images. There are programs that help show the hidden dimensions of things. (F, Int. 2)

Integrating ICT appears to be one of the most agreed-upon factors among all the teachers. Three purposes were addressed when ICT is integrated in science labs. First, teachers believed that students use ICT whenever and wherever they want; the most advanced technological devices are in the students' pockets. Thus, applying such technology in the class would direct students to use it to conduct open inquiries, investigate issues, and search for information. Second, teachers believed that advanced technology such as social networking applications, online games, and websites attracts teenagers; teachers found that they can gain students' interest and attention through technology. Finally, they acknowledged that ICT in the classroom provides great assisting tools for ensuring higher quality of teaching. For these advantages of integrating ICT, teachers believed that ICT would facilitate creative interaction in their classes.

To sum up, the educational setting in which educational policymakers regulate roles and principles should form policies that increase personal freedom of teachers and students. It should provide more time to apply pedagogical practices for creativity, and it has to acknowledge and reward both teachers' and students' endeavours for the sake of creativity. Also, integrating ICT is required. These four factors are related to the educational settings, according to the teachers. Nevertheless, the participants addressed other factors that are directly related to them, as discussed in the next section.

6.3.2 Science teacher-related factors

The teachers acknowledged personal-related factors, mentioning three factors in particular: the need to diversify their pedagogical practices, create a friendly and enjoyable atmosphere within the classroom, and link formal and informal science learning.

6.3.2.1 Diversifying teaching approaches

Seven teachers agreed on the need to use multiple pedagogical activities. They rejected the idea of using a particular method every time because it leads to negative feelings, such as boredom. Their statements are strongly connected with diversifying teaching approaches and avoiding students' boredom.

Zayed explained that, "as a teacher, you have to diversify your approaches to prevent students from feeling bored. If you enter the classroom with the same mood, the same clothes, the same method, and the same style, then the students will get bored" (Z, Int. 1). Similarly, Fahed pointed out that he ought to differentiate the teaching methods even if the topic does not offer enough space for variation. He talked about himself and said that "I cannot use the same approach each time I teach; otherwise the students will be bored. It is important to diversify and not use one approach of teaching" (F, Int. 2).

Ali also claimed that he tends to apply some methods that differ from other teachers to guarantee the continuous participation of his students. "I apply different approaches compared to other teachers who teach in the same classroom. I change my methods, and then the creative interaction of the students can continue" (A, Int. 2). Omar was very clear about the need to differentiate pedagogical practices as he believed that students are able to interact creatively if the teacher uses different practices. As he claimed, "students can be creative within many scientific topics, but teachers need to apply many activities. I mean teachers should not repeat similar practices every time" (O, Int. 1).

Generally, the teachers felt that they must avoid applying one method in very lesson. They called for the diversification of teaching approaches to foster students' engagement, evade boredom, and keep them interested and motivated to interact with their classroom activities.

6.3.2.2 Creating friendly and enjoyable classrooms

One of the factors related to the teacher is creating friendly classrooms. Teachers have taken into account the relationship between them and their students. Five teachers mentioned that students need friendly, funny, and enjoyable classes in order to demonstrate their creativity.

The teachers were convinced that students should be comfortable and like the science activities in order to become creative; this can be achieved through the teacher's practices inside the classroom. For example, Khalid stated that "teacher practices could make the students love or hate the science subject" (K, Int. 1). Thus, Jasser believed that students must feel comfortable inside the science classroom; they should have friendly relationships with their teacher. "Joking with the students and allowing them to have some fun are essential to make good relationships. [Such enjoyable moments] have a positive effect and help the students be enthusiastic and look forward to science classes" (J, Int. 1).

Omar highlighted his strategy for creating a friendly classroom by sharing and talking about students' interests: "I allow some time for them to talk about their interests, especially because they are at a young age. … In other words, I try to catch the attention of all students and create a warm atmosphere" (O, Int. 2). Similarly, Zayed felt that the teacher should appreciate the students' way of thinking, support them in maintaining positive feelings, and understand their interests to attract them. He commented that "you have to make the students feel appreciated for the hard work that they did, lift up their spirits, and share your thoughts with them. As a friendly class, I mean … you would have to go to their level for a while and try to think how they are thinking and what they are thinking about" (Z, Int. 1). He added that these aims justify the need for a friendly classroom, and he believed that being creative in the class depends on an individual's attitude toward the class, which in turn depends on the type of relationship between the teacher and the students. "Therefore, it is important to create a fun and friendly environment during the lesson" (Z, Int. 1).

Ali also indicated that this sort of classroom environment would positively enhance the students' feeling and make them more comfortable. Then, they would not have concerns about doing something unusual or asking a creative question.

> I think when the students … feel comfortable in class because of the welcoming atmosphere, they become eager to participate. When the students are given an

> opportunity to participate, then they can ask any question that they have on their minds. Sometimes they ask questions that they think are funny or they think do not have a real answer. … When this kind of environment is provided for the students, then the students would feel comfortable asking unusual questions. (A, Int. 1)

6.3.2.3 Linking informal and formal science learning

Seven teachers pointed out that formal science learning should be taught as daily life experiences. They believed that science topics are strongly connected with students' lives; therefore, formal science learning should be connected with informal science learning. They argued that this sort of focus could foster students' creative actions in both indoor and outdoor activities.

As a way of illustration, Fahed argued that the science learning should build upon local examples from students' environments. He justified his point of view based on the students' interactions with their local context; even science teachers should use examples from the students' surroundings to creatively engage with their outdoor environment. He recommended that teachers should " not use examples from outside the Kuwaiti context. Rather use examples from Kuwait. Then the student will be creative in his environment" (F, Int. 2). Fahed added that students will be "effectively engaged" with local events when informal learning is supported. Hence, he repeatedly stated that science learning at school should concentrate on "the daily experience of students" and offer "outdoor learning opportunities" in order to help develop the student's creative abilities (F, Int. 2).

Omar argued that teaching science through daily events and examples is an effective factor because creativity in science would develop students' society. "The subject of science is one of the subjects most incorporated with daily life. Therefore, it is very important to focus on examples from life. Creativity in science leads to the development of the society because science is connected with people's daily lives" (O, Int. 1). Omar supported his view by providing an example of developing the community if they teach science as daily topics. He spoke about connecting the theoretical topic with actual life and linked it to a local accident.

> After I teach the lesson about expansion, and after I demonstrate a practical experiment or a practical activity, I try to find informal examples from our daily life. For instance, what do you expect if we pulled out electricity wires? What would happen in the winter? It's cut off. Why do builders leave some space between bricks? This is because the country of Kuwait is hot, and if no space was left in between, then the walls would get destroyed during the summer…. (O, Int. 1)

Another science teacher indicated that students' informal learning and their experiences outside the classroom should be embraced by the science teachers via formal science learning. He shared his experience regarding this point of view:

> Formal learning has to connect science with reality. … Therefore, when I teach a lesson, I always ask how this lesson is useful in our daily life. This enables me to see how the students can use the lesson in their daily lives. Sometimes, I ask the students how they will use the information that they learned, and I give them time to come up with answers. This is a major point that I focus on, which is how will the information be useful in outdoor life and not on the exam. (A, Int. 2)

Hence, teachers argued for incorporating informal learning opportunities into science lessons to enable students to creatively deal with scientific issues in their context.

To sum up the teacher-related factors, the data analysis indicated that three facilitating factors are under the teacher's control: diversifying pedagogical approaches, creating friendly science classrooms, and linking formal and informal science learning. Furthermore, the teachers revealed other factors related to the students; these factors are seen as individual characteristics that facilitate creative endeavours.

6.3.4 Student-related factors

Finally, the teachers believed that even the students play an important role in terms of applying pedagogical approaches for fostering their creativity. Previously, they indicated that all students have the potential to perform and interact creatively, but this potential varied by individuals. The creative potential appeared to be related to other factors, such as being risk takers who are tolerant to ambiguity and being curious and interested about science learning.

6.3.4.1 Tolerant to ambiguity (risk taking)

Four teachers indicated that, in order to be creative, students should be challengers, adventurers, and risk takers. In other words, they should be tolerant to ambiguity to show commitment when doing new and unusual activities. The data analysis revealed that originality is associated with creativity, in which the student produces or reaches something unusual and new; such a process requires commitment and being tolerant to complete the task. For example, Mohammed stated that creative students are tolerant about discovering the unknown.

> If the student desires to understand a particular phenomenon and find out why and how it is occurred and what its scientific interpretation is, this indicates that the student is crazy about scientific research. He searches, he is an adventurer and tolerant; he wants to find the unknown and wants to know the scientific interpretation of this and that. All of this indicates that the student's personality is creative. (M, Int. 2)

Salem talked about risk taking as a significant factor and called for encouraging students to conduct exploratory activities to find new conclusions. He asserted that there is a need for "being risk takers" to be a creative student, especially when it comes to conducting "practical experiments" because it provides a great opportunity for "trial and error learning" (S, Int. 2). Salem added that reaching a creative outcome could "require a long period of time and a lot of efforts"; hence, students should be "confident and tolerant" (S, Int. 2).

Fahed held a similar view and mentioned that learning though "trial and error" should be fostered to help the students not be afraid of failing. Fahed believed that "experimental and exploratory activities" are better for the students to do themselves because they are somewhat challenging activities, and "creative students are challengers" (F, Int. 1). Moreover, Fahed believed that "students—in order to creatively interact—should deal with challenging activities, and they should not receive information on a golden plate" (F, Int. 1).

6.3.4.2 Curiosity and interest

All the science teachers addressed students' curiosity, which seems to be one of the most significant factors as it were mentioned repeatedly by science teachers on different occasions. The science teachers mentioned that a student's interest, curiosity, likeness, passion, and fondness were connected to creativity. Some teachers declared that there pedagogical approaches will not foster students' creativity if the students do not have such interest and passion.

> Creativity is an individual matter, which means that whoever desires to be creative, you cannot prevent him from being creative. You can only motivate this person. When the student loves a specific subject, he will desire to learn it. So, [teachers should] give students the freedom to choose what they like. (Z, Int. 1)

For example, Mohammed made a direct connection between loving a scientific subject and being creative in that subject. "If the student loves scientific interpretation, he will be creative. For instance, not only would he receive the facts as some information that he will need for the examination, but he will also want to find out the reason behind things, the scientific interpretation of things. He is fond of and curious to know" (M, Int. 1). He added that, without a student's love or fondness, all his pedagogical endeavours will not lead to creativity: "A student's interest is a major point in the educational process. He most love my subject and ask many questions…. I mean he is curious about my subject. If he dislikes science, my activities will not make him creative or even encourage him to participate" (M, Int. 1).

Another teacher held a similar view and argued that "students who show their passion for science will participate in a creative way". Such students are curious about a specific focus and "interested in inventing or discovering something new" (F, Int. 1). Meanwhile, Salem saw a student's interest and fondness for science as a distinctive line between creative and non-creative students in his subject. He pointed out that "one of the things that distinguishes the creative student is his love of the science, where the creative student would ask deep questions more frequently" (S, Int. 2).

Thus, Salem believed that the first thing that should be done to foster students' creativity is to attract students to the subject. He claimed that creativity could not be fostered without the students' fondness and interest. "When you succeed in attracting the students to a specific subject, you have passed the first step in fostering creativity. For me, there is no creativity without love for the subject and without attraction to the topic" (S, Int. 2).

Therefore, student-related factors can play a great role—as great as the educational setting-related and teacher-related factors—in the effectiveness of teachers' approaches regarding fostering creativity.

6.4 Summary

In this chapter, the findings were derived from interviews of eight science teachers. Each teacher was interviewed twice. Most of the extracts were coded from the first interview and a few extracts from the second interviews. The aim of this chapter was to answer the first and second research questions.

With respect to the first research question; the findings demonstrated two related themes: The first concerned the meaning of creativity, and the second demonstrated the pedagogical approaches for fostering creativity in the science classroom. The teachers perceived creativity as something original, imaginative, useful, and a potential of all people. Half of them believed that creativity is part of the scientific nature. Moreover, four pedagogical approaches were seen as appropriate for fostering creativity. The first approach is cooperative learning, which consists of group work, dialogues, and playful learning. The second approach is teaching thinking skills such as questioning, reasoning, problem solving, and brainstorming skills. The last two approaches are inquiry-based learning and experiment-based learning.

The second half of the chapter focused on the second research question to reveal the facilitating factors. Three major categories were identified: educational stetting-related factors, teacher-related factors, and student-related factors. More specifically, four factors are related to the educational setting—namely, offering a space of freedom, providing sufficient time, motivating students, and integrating ICT. The teacher-related factors included creating a friendly and enjoyable classroom environment; linking formal with informal science learning; and diversifying teaching approaches. Finally, the last two factors are student-related: The student should be curious and interested in science and be tolerant of ambiguity.

The next chapter answers the third and fourth questions by focusing on observed classroom practices compared with their professed beliefs. The chapter also reveals the mediated factors between science teachers' professed beliefs and applied practices.

Chapter Seven: Pedagogical Practices and Contextual Constraints (thematic findings)

7.1 Introduction

During the fieldwork, teachers' practices were pursued in order to perceive their daily classroom practices. The second aim of exploring science teachers' practices was to discover the contextual factors that mediate teachers' beliefs and practices. Thus, this chapter discusses the findings related to the third and fourth research questions—namely: What are the pedagogical practices of science teachers in Kuwaiti intermediate schools? and How do science teachers perceive the sociocultural factors that mediate their pedagogical beliefs and practices to foster creativity? With respect to the two questions, this chapter comprises two sections. The first section shows findings related to the third question about teachers' practices; the other section shows the findings related to the fourth question about the teachers' perception of the constraints that mediate their beliefs and practices.

Similarly to the previous chapter, the findings here are presented through across-cases synthesis. The actual pedagogical practices are discussed based on multiple methods of data collection: as lesson observations, researcher journals (field notes), students' focus groups, participants' drawings, and first and second interviews with teachers. Meanwhile, the section on mediated factors or constraints is based primarily on the second interview with teachers.

7.2 Science teachers' practices (RQ3)

The thematic analysis revealed that the identified categories can be classified under three major themes: goal-orientation, classroom practices, and extracurricular practices (see Figure 11).

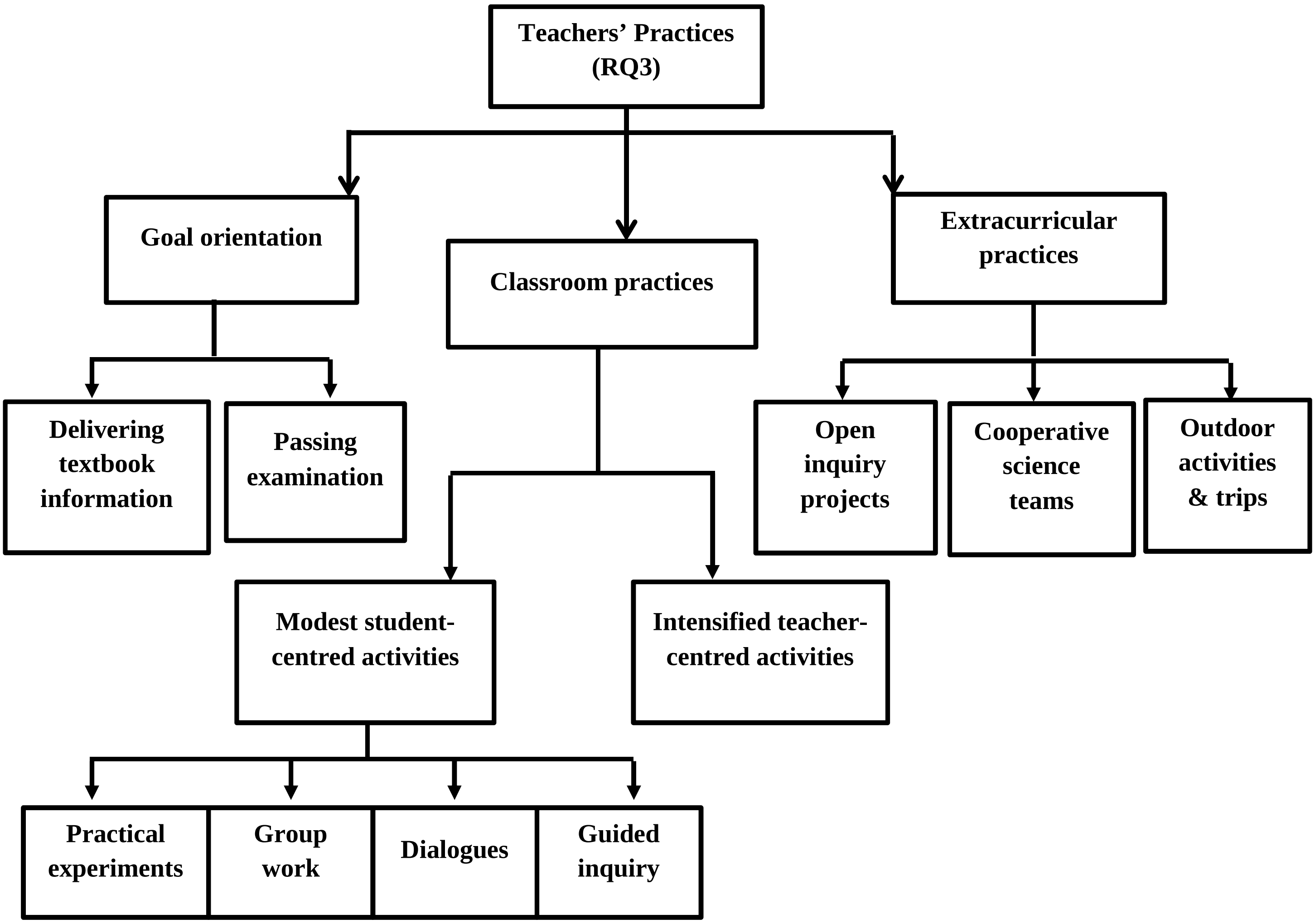


Figure 11: Thematic map of teachers' practices

Teachers and students clearly stated the goals of teaching and learning. Both teachers and students appeared to focus on achieving two targets: delivering textbook information and passing school examinations. These goals are clearly connected with the pedagogical approaches applied within the science classroom. With respect to classroom practices, the teachers conduct multiple pedagogical approaches classified as student-centred or teacher-centred approaches. Student-centred approaches are students' experiments, group work, dialogues, and guided enquiry; these approaches are insufficiently applied and adopted by science teachers. Teacher-centred approaches include giving lectures and using ICT for teachers' presentations; there were obviously apparent.

Meanwhile, extracurricular practices refer to three practices that were strongly evident: conducting open enquiry projects, engaging in outdoor learning through scientific trips, and forming scientific teams to cooperatively solve contemporary issues. These practices are conducted outside of regular class hours and are not compulsory for students. These categories from the thematic map are discussed in detail in the following sections.

7.2.1 Goal orientations

During the data collection, it was clear that teachers focused on two goals when they teach their students. The first goal is transmitting scientific information and concepts to their students. Teachers were very concerned about ensuring students' understanding of the scientific information from the science textbook. The other goal was helping students pass school examinations. The data analysis also found that these two goals are related: Teachers focused on students' understanding of textbook information because they it is more likely to be included on exams. Furthermore, these two goals are associated not only with teaching, but also with learning because the students found these two goals to be their core aims of learning.

7.2.1.1 Transmitting textbook information

Students' understanding of the textbook information was the priority of all science teachers. During my observations, I noticed that teachers were keen to repeat information and review the students' understanding. For example, Salem told me that he "used to apply the best activity in terms of enabling students to learn the scientific concepts of the lesson" (S, Int. 2). According to teachers' practices, it was obvious that "focusing on the general concepts and core information in each lesson" is a common goal shared by all teachers (F, Int. 2). This theme emerged not only throughout classroom observations and teachers' interviews, but also among students who participated in the focus groups.

To be quite frank, it was evident from my observations that teachers spent a large proportion of teaching time on maintaining and checking textbook information. Even the students were aware of this aim. For example, Omar's students exclaimed that their teacher repeats and emphases the major concepts.

> **Rabeh:** [Our teacher] used to frequently repeat the important things in the class.
>
> **Majed:** And he assigns them as homework.
>
> **Rabeh:** And he rewrites it in the textbook exercises besides the homework… to root the information in our mind. … Sometimes, the teacher says information out of the textbook for general benefit.
>
> **Waleed:** Or if a student is curious about something, the teacher tells him to do more searches on the internet. (O, St.FG)

Many observed examples indicated this goal, probably due to teachers' stubborn desires to prepare their students for the exams. For example, Ali spent more than 20 minutes explaining and repeating the process of electronic distribution without any interaction from his students. Interestingly, Ali said at the beginning of the session that "all students should stop talking and focus because the 'Quantum Numbers' lesson is going to be included on the monthly exam" (A, Obs.3).

> **9:02** the teacher reviews the last lesson with students; then, he asks them to focus on the video clips that clarify the meaning of quantum numbers.
> **9:09** the teacher connects his iPhone with data show and plays the PowerPoint slides. After each slide, he repeats the information, with some followed by questions to check his students' attention and understanding.
> **9:18** the teacher moves from PowerPoint to the quantum board. He is explaining the PQN by exemplify electronic distribution. He also records the main points of his presentation on the white board, including some drawings.
> **9:25** again, he reviews the students' understanding of the lesson. He asks a number of questions and then asks students to write the summary from the white board. (A, Obs.3)

Ali admitted that his focus on textbook information is significant in terms of passing exams: "The first thing is to teach the concepts that were mentioned in the textbook and how the students deal with these concepts. The concepts and information are important for passing the exams" (A, Int. 2). Passing the exams appears to be a chief concern and fundamental goal to be achieved. The other revealed goal is passing examinations and gaining grades.

7.2.1.2 Passing examination

Six out of the eight teachers acknowledged that the goal of teaching and learning science in their current classes was to help their students pass school examinations. It appears that the students seek the grades necessary from their teachers to pass school examinations. On the other hand, the teachers were focusing on things that are more likely to be asked in the exams. Furthermore, the teachers expressed that parents also have a tendency to see high scores in their children certifications. Some teachers (Fahed, Salem, Jasser, Mohammed) explained that this tendency is common among parents and students seeking to enrol in universities and find jobs.

Ali pointed that "students fear exams; they only study for exams to get marks which consequently constrains their thinking to focus only on examinations" (A, Int. 1). Such student concerns were evident inside the classrooms, where 25% of the marking system is assigned for oral examinations and classroom participation. I noticed that, when the teacher marked students' answers and participation, students became more active and interested in sharing their thoughts.

For instance, Fahed used oral assessment marks to encourage his students to interact during classroom activities. When he was teaching about fossils, he said "whoever offers the best answer and inducts the definition of ecological system and ecology will get extra marks on their oral assessment". He used the oral assessment notebook and told them "do not worry. If you offer a wrong answer, it will not be marked" (F, Obs.4). In his second interview, I sought to find out why Fahed said that students focus on marks and examination and why he frequently used marks during the classroom activities.

> **Fahed:** Frankly, parents and their students are not concerned with developing the creativity side. … Maybe some are, but the majority are concerned with marks and success. … The current policy and people do not foster creativity. In the Gulf States and Kuwait, the primary concern is grades and certifications to get a job. I think that people here think in that way, although fostering creativity is an excellent aim. For example, if there is an underachiever in science, but he is creative in math, there is no higher educational system that accepts this student. He will be refused because of his failures in science; he should at least pass science. I mean, the student could be an underachiever in a particular subject because he is not interested and creative in another subject because of his passion for it. I think it is necessary to have universities that accept this kind of student. (F, Int. 2)

7.2.2 Classroom practices

Pedagogical practices were observed and identified, and the findings revealed that the teachers apply a wide range of approaches in their classes. Basically, there are approaches that stimulate students' participation in and interaction with classroom activities. In these approaches, the students become the core of the learning processes under the teachers' supervision. Other approaches rely on the direct transmission of information. As a result, the teachers' activities become the foundation of teaching and learning processes, while the students become quiet listeners and passive receptionists. Thus, the approaches are classified under two major categories: student-centred and teacher-centred approaches.

7.2.2.1 Modest student-centred approaches

As revealed in the previous chapter, teachers mentioned multiple approaches that foster student creativity, such as conducting experiments, engaging in enquiries, offering cooperative learning activities, and developing thinking skills. The teachers argued the need to apply these approaches and avoid dictation and the direct transmission of information. They believed that teaching creativity is associated with approaches that rely on students' interactions and engagements.

Nevertheless, student-centred approaches appeared to be insufficiently applied in science classrooms. The teachers admitted that student-centred approaches were limited because of different constraints. Hence, this section examines the student-centred approaches (i.e., practical experiments, group work, dialogues, and guided inquiries) applied in the science classroom as well as their deficit.

7.2.2.1.1 Practical experiments

In the previous chapter, teachers indicated that conducting experimentations is an appropriate approach to foster students' creativity in science topics; thus, they strongly supported activities that rely on students' experimentations. Similarly, the data analysis of focus groups and students' drawings also indicated that doing lab experiments could inspire students to perform creatively. However, the observed lessons exposed that teachers tend to conduct scientific shows by themselves for their students, instead of enabling students to conduct the experiments on their own. Teachers also tend to allow their students to conduct specific experiments that are included on the practical science exam.

With students, it appeared that conducting experiments is an important approach for being creative during classroom practices. Students pointed out that these activities depend on their participation, especially, their physical and sensory engagements. For example, one of Zayed's students believed that learning through practical applications inspires him to be creative: "Doing things by hand inspires me to be creative and active in science. … I mean doing lab experiments. It means I am someone who constructs, puts, mixes, observes, and infers [the conclusion of the experiment]." (Z, FG, St. Mishal). Similarly, students from Fahed's class recalled an example where they had to create different situations to examine and observe human reactions.

> **Yassin:** Hmmm. For example, we have done an observation about human actions and reactions … in which you put your hand on hot surface and immediately pull your hand away without thinking. It was fantastic.
>
> **Jarrah:** It is compulsory action. If you put your hand and you are watching another thing, you will pull your hand first then look to the hot surface. Pull then look is an unwilling reaction.

> **Tareq:** For example, when your brother gives you a cup of hot water and you don't know it. You will quickly throw it away then look at it. I really like this activity; we have conducted many ideas to understand human reactions. (F, St.FG)

Despite the fact that the teachers' interviews and students' focus groups addressed fostering creativity via conducting practical experiments, the observations revealed that students conducting experiments was poorly applied. Rather, teachers preferred to do the scientific demonstrations themselves as an alternative to enabling students to conduct experiments on their own. Most teachers justified their preference by pointing to constraints such as the lack of time, the lack of tools and materials, and fears about creating chaos. At the same time, teachers enabled their students to conduct experiments that were more likely to be included on the practical test at the end of each semester.

For instance, I witnessed practical activities on different occasions. It was evident that teachers did not apply all the experiments suggested by the science teacher book, but they practiced with their students the experiments related to the workbook exercises. Therefore, I sought to find further explanations for why practical activities are limited and replaced by scientific demonstrations. One teacher said that "it is difficult to prepare tools and materials for more than 23 experiments" to allow each student to do the practical activity (S, Int. 2). Other teachers (Khalid, Jasser, Omar, and Zayed) indicated that there is a lack of materials to for all students to conduct the experiments. Meanwhile, Ali stated that some experiments do not foster creativity; they are just for delivering information. Thus, allowing the students to do them is a waste of time.

> I evaluate the experiment first [to determine] if it requires specific skills or not, if it embraces new ideas or not. For example, melting ice cubes is an experiment, but it has nothing to do with creativity; it is a demonstration only to deliver specific information. Also, it is a dangerous experiment; I need to prepare ice cubes and gas pipes for all students. It is waste of time and does not reinforce the students' creativity. Such an experiment is only applied for explaining particular information. (A, Int. 2)

7.2.2.1.2 Group Work

Classroom practices that rely on collective endeavours were noted within each case study. Participants believed these practices were pedagogical approaches for fostering creativity in the science classroom. As discussed in the previous chapter, the teachers strongly believed in cooperative learning approaches, especially group work. Teachers found that it offers a great opportunity to build different communication skills, generate many ideas, and draw proper conclusions.

The observed classroom practices indicated that teachers apply group work activities. However, all the group work activities were applied as part of a lesson, and they were done in a short time. For example, the longest group activity was observed in Ali's class when his students worked in groups to conduct experiments about deducing the law of mass conservation. The activity lasted more than 25 minutes. In addition, Khalid and 11 students worked cooperatively to explain the Rutherford model of the atom; the activity required more than 15 minutes. Regarding the remaining observed group work applied for a short period of time (usually less than 10 minutes), a typical example occurred in the first observed lesson in Fahed's class. He was teaching his students about environmental adaptations; therefore, he asked them to work in 5 groups to examine pictures to determine how animals adapt themselves.

> **Teacher:** We will look at the pictures and identify the adaptations of each animal. Each group will discuss the pictures and find the adaptations.
>
> **Note:** Students are divided into five tables; members of each group are looking at the pictures and talking about the animals' features. Meanwhile, the teacher is moving around the groups and observing what they are doing.
>
> **Note:** After a while, the groups start to offer their answers and explain how these features are useful for the animal. The teacher discusses each answer with them and adds some information about the students' view. (F, Obs.1)

With respect to the students' experience, they felt that group work is a helpful and enjoyable practice. They identified several benefits of working within groups, such as becoming confident, confirming conclusions and answers, cooperating, and assisting each other. For example, Zayed's students discussed the following benefits of working in groups.

> **Hamzah:** All of us cooperate to answer one question. I mean–
>
> **Sami:** –we deliberate.
>
> **Mishal:** This is better. I like it … because it makes us cooperate.
>
> **Hamzah:** Also, it gives confidence in our answers.
>
> **Sami:** It is enjoyable because all of them deliberate on their task.
>
> **Hamzah:** If someone is alone, he will be afraid and be stressed.
>
> **Sami:** Yes, he will be stressed, and his information will be disorganized. So the group is better. For example, one shares information and another shares information, then they can have a great answer.
>
> **Thari:** Also, a student can have the correct answer but an incomplete one. So, the students help each other to have complete answers. (Z, St.FG)

The analysis of focus groups demonstrated rich extracts of students' views in this regard. When I was conducting the focus group interview with Jasser's students, one of them strongly argued for group work. He stated that group work activities "teach us about doing useful things. They teach us how to cooperate and at the same time we understand the lesson. … We will benefit from this when we get older" (J, GF, St.Essa). One of Salem's students drew himself with his friends, depicting them as smiling and working together; he wrote "My friends and I cooperate to conduct laboratory experiments" (S, FG, St.Bader).

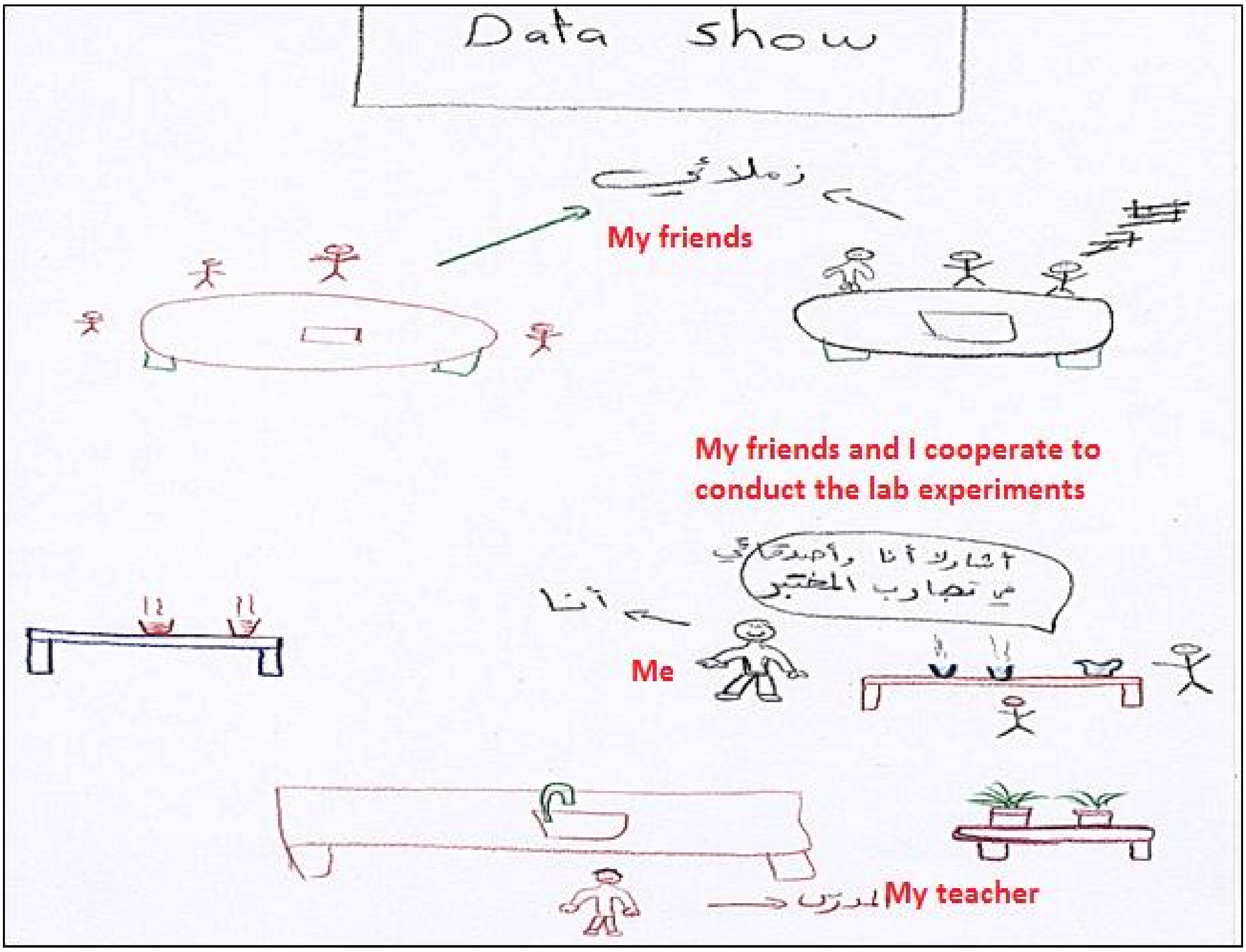


Figure 12: Student's drawing (S, FG, St.Bader)

Overall, the findings indicated that group work is applied in science classrooms. However, the teachers do not offer enough time for group work activities. Such activities were conducted in a short time, although students found group work to be an inspiring approach to being creative, active participants and cooperating with their peers.

7.2.2.1.3 Dialogues

Discussion and deliberation between teachers and their students were noted across the cases. It was obvious that 6 out of 8 teachers encourage their students to discuss with them and share their points of views about the topic being taught. Teachers initiated their new lessons with a major question, then encouraged their students to discuss the questions and deduce the major concepts of the lesson. As Ali said, “when I pose questions, the students may offer unexpected answers.

So by raising questions and discussing their responses, the students can reach the answers on their own" (A, Int. 2). Fahed, in his first observed lesson, taught his students about environmental adaptations. Most of the lesson relied on the discussion between Fahed and his students.

Fahed: Can you tell me about the basic needs for all creatures to live?

St. Bassel: Water.

Fahed: Okay, and what else?

Note: Fahed records the answers on the white board. At the same time, some students speak randomly and provide some answers, such as food, air, oxygen, weather.

Fahed: Good answers. Creatures need oxygen to breathe, water to drink, food to have energy. Thank you, guys. Good answers. But I want more explanation about weather.

Note: Silence for few seconds. … The teacher's eye contact is not stable; he is looking for someone to say something.

St. Jarah: Weather helps animals live.

Fahed: How does the weather help?

St. Jarah: Ahh, I mean high temperatures kill animals because they should live in cold places.

Note: Other students participate to give examples. One talks about his experience.

St. Yassin: I was at the Friday market and I saw a husky dog. He was very beautiful. I asked my father to buy it for me, but he said no because it would die in the summer because he needs cold weather.

Fahed: Right, even the camel—all of us have seen it, right?

Students: Yes (loudly).

Fahed: The camel can live in the desert, but it's hard for it to live in cold places. Okay, I need you to tell me about the giraffe. How does the giraffe obtain these basic needs?

Note: The students think about the question as they study the photo of the giraffe. They try to find the answers from the picture while the teacher records the students' responses on the white board. Other students would like to participate; they are raising their hands to have permission to answer. Fahed picks one to talk.

St. Musaid: The giraffe is very tall and has a tall neck to take food from trees.

Fahed: Good, right answer. Now, I want you to work as groups and look at the pictures in the book and find out about the adaptation of each animal. (F, Obs.1)

Teachers appeared to hold concurrent points about this approach, using questions to spark the students to participate in a dialogue to draw conclusions. For example, Salem expressed that it is beneficial to "start the lesson with a question to let the students think about the targeted scientific phenomenon. Then, it can establish a discussion by posing a series of questions." (S, Int. 2).

Nevertheless, I noted that dialogue among students was restricted under the teachers' control. The teachers did not encourage students to discuss the subject with each other. Sometimes, they allowed the students to discuss only within their groups. In other words, despite the teachers' strong belief about the dialogic approach to foster students' creativity, it was obvious that the teachers tended to control the dialogues inside the classroom. For example, Salem, during his fourth observed lesson, asked his students to work as groups to explore soil samples. However, he did not allow them to freely discuss within the group, and he kept saying "be quiet" and "work silently":

Salem: What do you expect to see when you dig in the school garden? … Is the soil identical?

St. Shafi: No, there are different sizes and colours.

St. Othman: Also I can see yellow leaves.

Salem: What else? … Discuss with you group but do so quietly.

Note: There is some whispering in each group. One student is raising his hand.

Salem: I told you to be quiet… Yes, Shafi, what do you want to say?

St. Shafi: My father puts down fertilizer every winter for our palm trees.

> **Salem:** Nice, so this means that the soil is not identical. Okay, I want you to think about the formation of the soil. How did the soil form? … Connect this question with the last 3 lessons regarding weathering and rocks.
> **St. Jamal**: Soil is a group of little pimples from large rock. Weathering is the cause of making this group.
> **Note:** The teacher refines the student's answer and writes it on the white board. After that, he asks the students to work in groups to describe the soil of the school garden and record the components in their notebooks.
> **Note:** Students are divided into 5 groups (5 tables); they spill the soil onto A4 paper and start to look at it and discuss with their peers. They open their workbooks and read the exercise. (S, Obs.4)

Salem constrained the discussion among each group; he did not allow the students to speak to each other in order to sustain the class discipline. In general, student–student dialogues appeared to be controlled by not only Salem, but by the other teachers as well. The teachers were concerned about creating a space of disturbances and chaos. As Omar admitted, teachers avoid cooperative approaches such as group work and dialogues to "prevent chaos" (O, Int. 1). Other teachers stated a similar view; they want to avoid any chance of chaos inside the classroom.

7.2.2.1.4 Guided inquiry

Guided inquiry is a fundamental element of the teacher's lesson plan, as there is a subheading called "More Inquiry" at the end of each lesson plan. Science teachers were asked to stimulate guided inquiry by posing open questions at the end of each lesson. It is compulsory to note down in their lesson plans the open questions or statements to be searched by students; however, the teachers did not pay enough attention to this practice. It was rarely applied by the teachers, even though they and their students found it to be an effective approach for creative students.

> More inquiry practice is for the sake of fostering students' creativity. However, very few students seriously deal with this practice, so in turn the teacher forms a negative reaction about this practice. [The teacher] becomes unenthusiastic and does not ask

his students if they conducted an inquiry about this or that. He does not want to waste time if only a few students conduct inquiries. (J, Int. 2)

Jasser stated that the limited number of students who conduct inquiries is not the only reason for neglecting this practice; other reasons include time limitations and rich content. Likewise, other teachers (Zayed, Salem, and Omar) acknowledged that they do not have time to conduct the guided inquiry and review students' responses.

With respect to students' experiences, the data analysis of focus groups revealed that students focused on conducting inquiries as a technique because it inspires them to come up with something new. In the first example, students from Salem's class indicated that their teacher used to conduct guided enquiry. They pointed out:

Jaber: The teacher says to search for information about this and that.

Hassen: Yes, I used the internet to find information about the weathering process. The teacher told us to write the word weathering in English, and you will find more information about the lesson.

Bader: Doing these inquiries develops new ideas.

Jaber: Yes, and these investigations also enhance our ideas. (S, St.FG)

In another example, students from Fahed's class expressed their experience about conducting inquiries verbally and visually. For example, one student drew himself presenting his report about savannahs in science class; he also indicated that such an activity could lead him to create new conclusions.

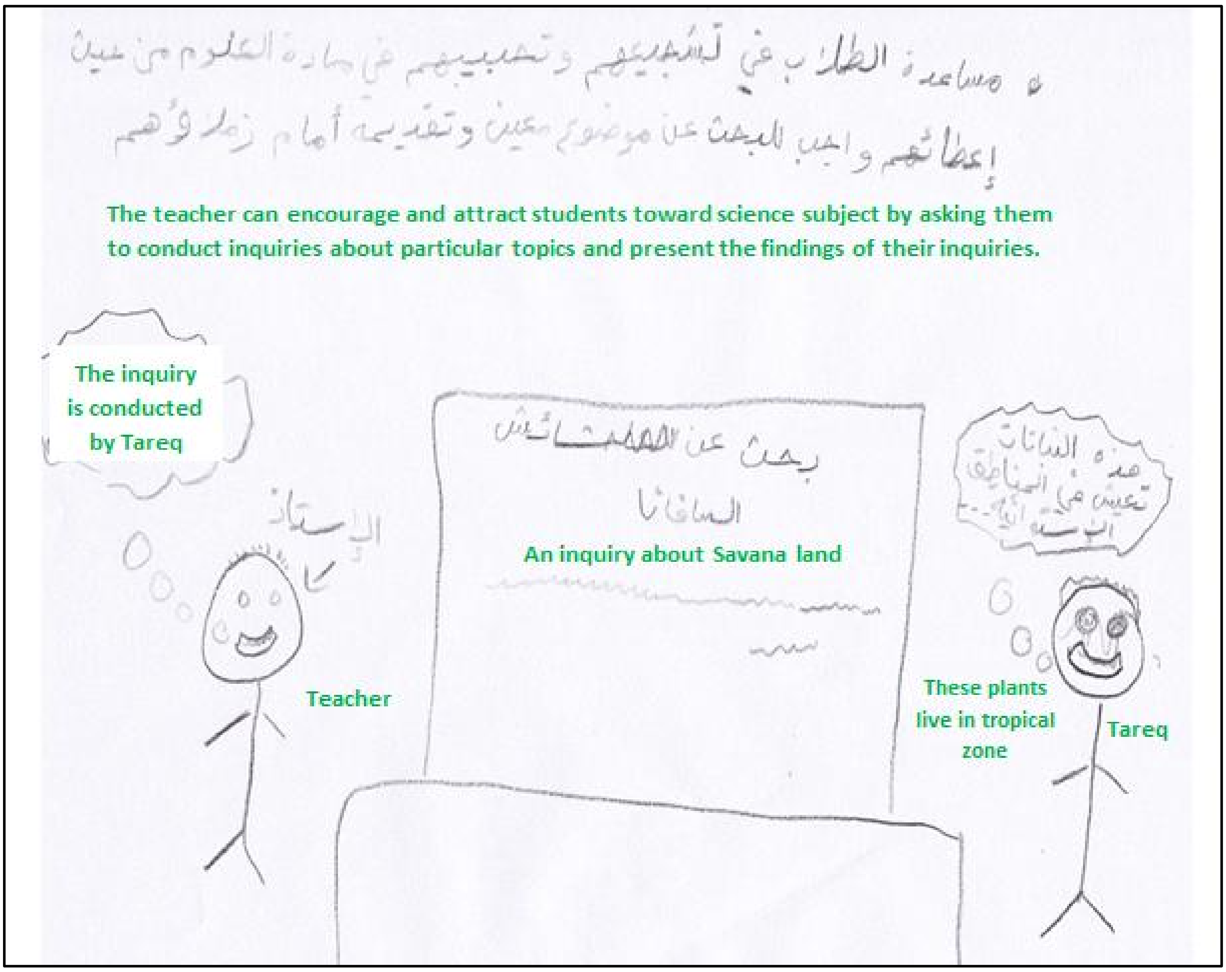


Figure 13: Student's drawing (F, FG, St.Tareq)

Tareq: I searched to find some scientific experiments. For example, I conducted an experiment with candle and vinegar. … I mean I used the idea which I found … I used it in different way. Perhaps, I can invent something else from it.

Thamer: Once, I did a research about electricity consumption. I searched on websites and Google; I concluded that air conditioners are the highest in terms of electricity consumption. Then, I wrote a report about it and submitted it to my teacher. (F, St.FG)

7.2.2.2 Teacher-centred approach

It is true that the data analysis revealed that student-centred approaches (e.g., dialogues, group work, students' experiments, and guided enquiries) are applied, but they were not sufficiently applied. Moreover, the observations demonstrated teachers' adaptation of teacher-centred approaches. Obviously, lecturing and presentations via ICT were repetitively noticed in all cases.

Once lecturing was applied, the students appeared to be passive, quiet, and unimpressed; students remained seated at their desks while their teachers spoke for a long time. During the lectures and presentations, the teacher became the source of teaching and learning; meanwhile, students did not interact unless they received permission from their teacher. All the teachers, with no exceptions, appeared to be lecturers who delivered instruction and transferred knowledge to their students. Although the teachers did not appreciate such approaches and believed that they were not appropriate for fostering students' creativity and thinking skills, their presentations and lecturing approaches were heavily applied.

Zayed, who stressed the significance of diversifying teaching approaches, was extremely keen to deliver as much information as he can during his classes. He referred to the thickness of the textbook and the extensive amount of information included to justify his lecturing approach. In one of his observed lessons, I concluded that:

> The teacher was speaking about arthropods during the whole session; meanwhile, his students were exclusively listeners. He was presenting a lot of information about many insects. To be honest, I expected Zayed to give a long lecture after I looked at his lesson plan, but it was shocking that he did not support any student activity. He was in hurry to teach the subject. And I could not keep focused on his presentation; it consisted of too much information to be presented in one session. (Z, Obs.2)

With respect to Zayed's students, they pointed out that teacher presentations make them feel that science class is far from fostering creative performance. For example, St. Mishal described the students' status during the arthropods lesson. He drew the teacher talking about the kinds of arthropods; meanwhile, the students are silent as they look to their teacher.

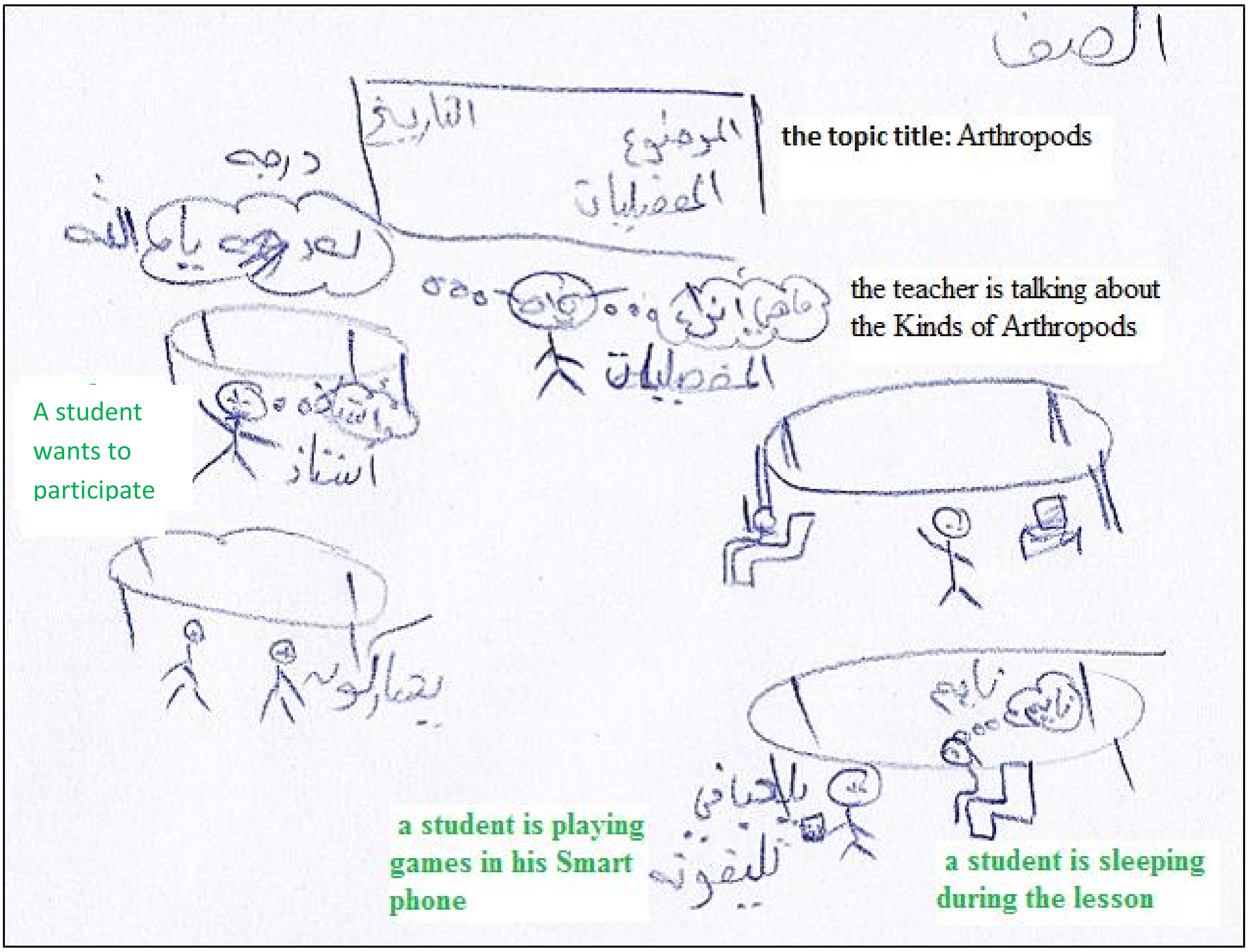


Figure 14: Student's drawing (Z, FG, St.Mishal)

Mishal: I like the science subject, but I do not feel that we can be creative in it

Researcher: What do you mean?

Mishal: I can be creative when we do experiments and projects… but in the class I do not feel that there is creativity

Researcher: Why do you feel like that … (interpreted by s3)

Sami: Most of the time is spent on presentation and explanation … but students' activities are limited.

Mishal: We always remain seated during the session.

Sami: The session is full of presentations and writing summaries (Z, St.FG).

Generally, giving a lecture was apparent, despite the fact that teachers believed that it is not an encouraging approach to foster student creativity. In addition, the students indicated that when teachers speak and they remain seated to listen, they do not feel that can generate any creative actions or ideas.

Similarly, the observations revealed that all teachers apply different technological devices when they are teaching, such as interactive screens, iPhone, iPad, laptop, and overhead projector. These devices were used to demonstrate multimedia materials as learning tools. Some teachers (Fahed, Salem, Khaled, Jasser, Mohammed) expressed their views regarding facilitating learning and varying pedagogical approaches by applying ICT inside the science laboratory. However, the observations revealed that teachers' adaptations of ICT during the lessons foster the teacher-centred approach and facilitate the direct transmission of textbook knowledge. The ICT devices were exploited to serve teachers' presentations rather than increase the interactivity within the class. One of the most obvious examples is Salem, who used PowerPoint and other multimedia materials in all of his observed lessons. The four observed lessons were about weathering, and he conducted a similar approach in each session, as in the following:

> Salem used his iPhone to show some visual examples of rocks that were affected by chemical weathering. He played short flash clips to show how the water can crumble the rocks. After that, he opened the textbook though his iPhone to sum up with his students the main concepts of the lesson. He spent the whole session moving around videos and pictures to explain issues about weathering. Meanwhile, the students followed his presentations and data show. (S, Obs.4)

After observing the fourth lesson, Salem participated in the second interview. When asked to justify his heavy dependence on ICT use in teaching, he stated that using ICT for the sake of saving time is one of the most significant constraints. He believed that "using technology such as laptops, interactive boards, and iPhones saves time during the class. For instance, showing a video for five minutes over the projector with an explanation saves 15 minutes of regular teaching" (S, Int.2). Using ICT to save time and deliver information was not only justified by Salem, but also mentioned by the other teachers. The majority of observed lessons included multimedia materials. It appeared that teachers' presentations consistently relied on ICT use in order to serve their teaching plans. Therefore, it was evident that this technology was exclusive for teachers' presentation, while the students were a passive audience, in which they did not employ the available technology in their learning activities.

7.2.3 Extracurricular practices

All the teachers referred to extra science activities that are not considered compulsory for students and are not integrated into the assessment criteria to assess the students. Interestingly, the data analysis revealed that all teachers found that this sort of activities fosters students' creativity and enables students to creatively perform on different occasions. Moreover, the teachers themselves held positive beliefs about these activities because confronting constraints is delimited compared with the compulsory classroom activities. Therefore, the observations revealed that teachers' practices within extracurricular activities differ from their practices within the regular science classes. For example, these practices were student-centred and depend on their interactivity and involvement; brainstorming, problem solving, student–student dialogues, open inquiry, and cooperative learning were evident within the extracurricular sessions. I found that these extra practices are categorized under three themes: science teams, outdoor activities, and open enquiry projects.

7.2.3.1 Scientific teams

During the fieldwork, I found that teams of students participate in extra activities, such as environmental, medical, investigative, agronomy, and laboratory teams. Each team sets up a weekly meeting to discuss their area of focus and plan for a specific project. As Salem described, this kind of activity is done by "forming a team that has a common goal and equal responsibility. As the members of the team have to get together to discuss things to give the opportunity to everyone to speak his mind freely and interactively" (S, Int. 2).

Salem was very optimistic in terms of fostering creativity within these scientific teams. “The extracurricular activities basically target developing the social and creative behaviour more than the other class activities do” (S, Int. 2). For example, I observed the introductory meeting of the environmental team. Nine students and Salem were sitting in the laboratory room. “Salem was applying a brainstorming technique in which each student is generating ideas for the coming activities of the team. Salem did not add any ideas; he was writing up the students’ suggestions. After the brainstorming practice, the students divided themselves into three sub-groups by voting. Each sub-group has certain tasks to do” (S, FN).

When I asked Salem about his enthusiastic attitude toward this sort of activity, he justified that “this is completely different from working in the regular class as we have to abide by a set of written and oral rules” (S, Int. 2). He felt that the teacher and the students have space to freely work as a group without being directed by constraints. Salem shared his experience and offered an example of his students’ activities as an environmental team.

> I remember that our environmental team gained a creative experience last year, when one of the students suggested decorating the garden with four flower colours as to form the shape of the Kuwaiti national flag. They wanted to celebrate Kuwaiti National Day. The idea was simply nice and economical for the budget of the school. Our team started growing the flowers. As a result, all the students creatively used all the knowledge they had in the environmental team for celebrating a social occasion. (S, Int. 2)

Ali also agreed with the role of extra activities to prompt students’ creativity. He told me about a scientific exhibition as an activity that offered the chance for the students to do something creative. “When we did a scientific exhibition, for example, we encouraged students’ creativity” (A, Int. 1). He said that “one part of the exhibition was more creative as it was confined to funny experiments made by the students’ teams who were there to explain their experiments to the audience” (A, Int. 1).

After the interview, Ali shared some photos and video clips of the exhibition with me. Ali strongly believed that, when the students have space to think and search about something, they can come up with new or developed ideas. He claimed that the students were very interested and active before the exhibition in terms of conducting attractive experiments for the visitors. Although Ali and I were sitting in the science department, Ali argued that the nature of extracurricular activities depends on offering free space. He showed me different examples of the teams' work. He appeared to be very enthusiastic about this sort of activity; at the same time, he was disappointed about the compulsory classroom activities in which he compared the two kinds of activities (A, FN).

Omar also shared a similar view and stated that science teams' practices offer real chances for fostering creativity through scientific subjects.

> The activities proposed by the science teams cultivate a creative environment and provide the students with a precious opportunity to think of a project based on the idea of protecting their local environment and solving its problems. There is also the health group focusing on the medical field, besides there is the agronomy group, where you can find the students growing plants and taking care of them. They also take pictures of their plants throughout all their growing stages, noting the differences and writing full reports about their own experimentations. (O, Int. 1)

7.2.3.2 Outdoor activities

Six teachers stated that trips are important practices that stimulate students to conduct inquiries about new issues. Through trips, students are able to meet their specific interest in a particular area and offer learning opportunities that the classroom activities cannot offer because "these trips are funded by institutions that have more advanced equipment that schools do not have" (F, Int. 2). Throughout the data collection, several outdoor trips were arranged, such as to a solar energy station and a fire station.

Fahed explained that trips can connect and strengthen the relationship between science subjects and students' lives. He believed that "scientific outdoor activities enrich topics of different fields and help the students learn about unusual phenomena. [Trips] help the students see the other side of science and how to best use it in our life" (F, Int. 2). Fahed claimed that trips can confront the school deficiencies. It appeared from his response that the school has to deal with its own limitations to meet students' interests.

> You can find instruments and inventions in the National Kuwaiti Science Club which are not available in the schools. The students interested in learning about astronomy can visit the club to enjoy watching the solar system which is not available in their school and see the flames coming off of the sun based on very advanced technologies. (F, Int. 2)

Khalid and Jasser made similar sentiments about scientific trips, but they were keener to show how these trips foster students' creativity. For example, Jasser focused on students' stimulation; he noted that students become very interested and do preliminary investigation before the trip to prepare questions for the trip. "Once the students hear that they will make an outdoor trip with their teachers, they become very enthusiastic about it. The idea of having the trip stimulates them to prepare questions and to search for their answers" (J, Int. 2). Khalid stated that trips can foster creative behaviour as students would collect data, document the trip, and ask professionals questions. "When the intermediate stage student goes on these trips and visits libraries searching for data, taking pictures and meeting university professors, he is going to have the opportunity to develop his creative behaviour" (K, Int. 2).

7.2.3.3 Open inquiry projects

Science teachers are required to supervise science teams' open inquiry projects, such as scientific research and robot research. All the teachers commented that these activities are positively perceived as opportunities to accomplish creative work by their students. According to the teachers' declarations, the reasons for believing that such an approach can foster students' creativity are that they 1) meet the students' area of interest; 2) support students' autonomy; 3) offer space for time and freedom; 4) lead students to form and manage a research team; 5) and allow students to learn from multiple resources.

“The scientific research competitions afford curious students the freedom [and autonomy to conduct] open inquiry that could require long-term activities” (O, Int. 2). According to Omar, Salem, and Fahed, students who participate in such activities become autonomous; their teachers merely supervise them. Omar referred to his students’ project about water consumption, saying “the students started to apply many of their ideas and I was just their supervisor” (O, Int. 1). Likewise, I observed Fahed with his students when they were working on creating a poster to demonstrate their findings.

During the second interview, Fahed commented that “the scientific research competition depends on enhancing the creativity of the students in the scientific field. They do everything, from A to Z, and they work on a project they choose themselves” (F, Int. 2). Like the other teachers, Fahed argued that students manage the project themselves; they distribute the assignments among the team/ “For example, someone goes to search, someone else would check the data, and one takes pictures” (F, Int. 2).

Another teacher confirmed that students manage the entire project, while he and his colleagues only guide them. According to Zayed:

> Once [science teachers] make an announcement on the school noticeboard, many interested students rush to participate. They actually … propose a lot of creative ideas. [Science teachers] try to help the students by discussing things together. However, the students do the whole thing; we as teachers are only supervising them. (Z, Int. 2)

Finally, Jasser explained that open inquiry competitions among schools “are really important as they develop and enhance the abilities of the students to create” (J, Int. 2). He acknowledged that such an approach facilitates students’ abilities in managing, collecting, discussing, conducting experiments, writing reports, referencing, and meeting the assessment criteria on their own. Therefore, “the students who like science are the ones who are involved in these activities as they must have the desire to explore and problem solve” (J, Int. 2).

7.3 Mediating factors (RQ4)

The teachers discussed a range of mediating factors that intervene in their beliefs and practices; these mediating factors appeared to be constraints that prevent teachers from putting their pedagogical beliefs into classroom practices. Thus, such constraints should be addressed in order to apply creativity-fostering practices inside the science classroom. The data analysis indicated that constraints can be categorized into three main categories: internal, external, and interpersonal constraints, as illustrated in Figure 15.

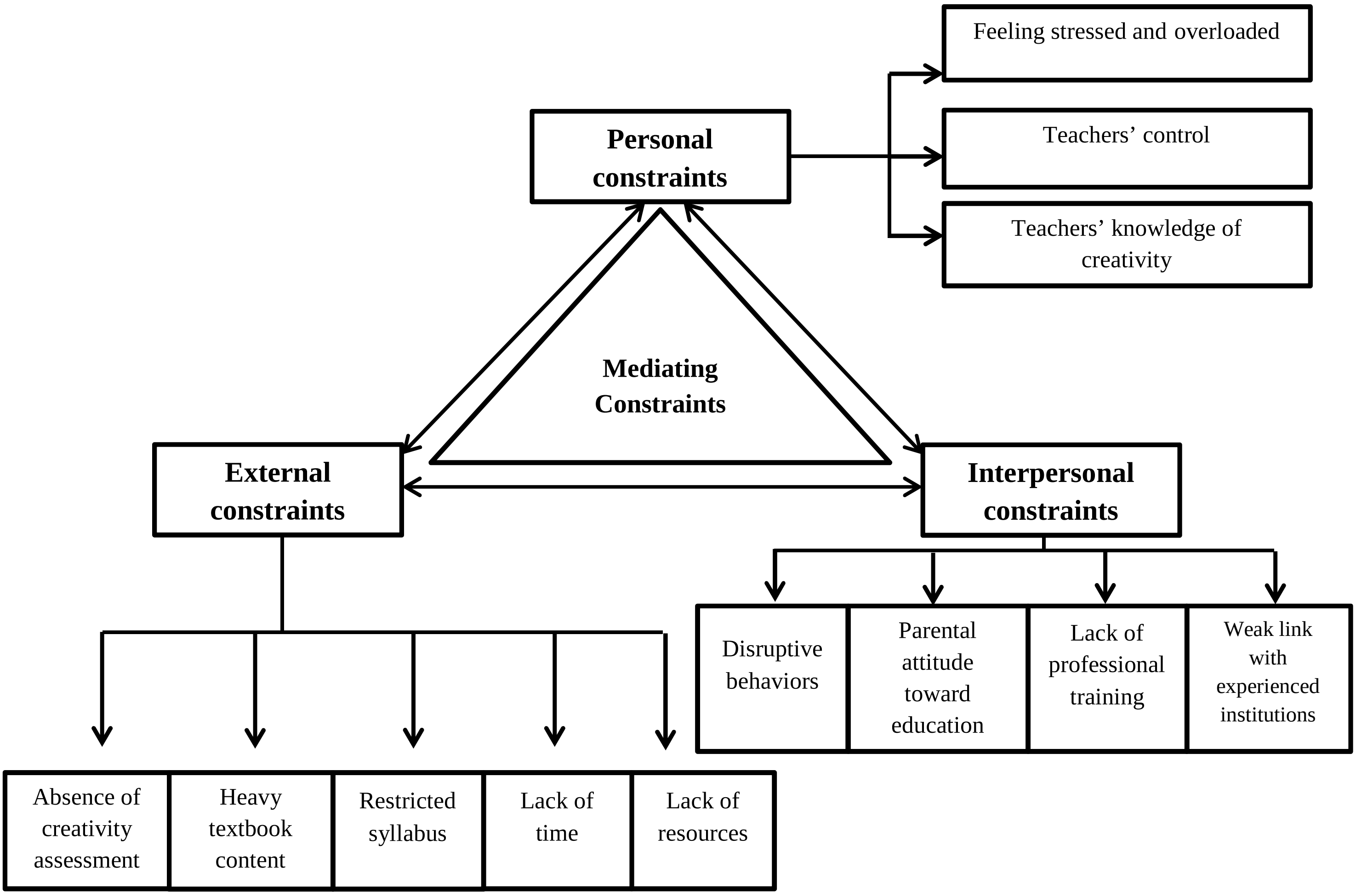


Figure 15: Thematic map of the constraints mediating beliefs and practices

Personal constraints are related to the teachers themselves, such as feeling stressed and overloaded, teachers' control, and the lack of creativity-fostering knowledge. Meanwhile, external constraints stem from teachers' management issues, such as a lack of time, a restricted syllabus plan, a thick curriculum, and the absence of a creativity assessment. Interpersonal constraints refer to the impact of individuals with whom teachers interact within the educational context, such as parents' attitudes, students' disruptive behaviours, lack of professional training, and poor links with experienced institutions. The themes under the three main categories appeared to be related and interacted to affect how teachers integrated their beliefs into practices.

7.3.1 External constraints

The external constraints refer to contextual factors associated with the educational system. Five constraints emerged from the data analysis: absence of creativity assessment, thickness of textbook content, restricted syllabus plan, lack of time, and lack of resources. The findings below illustrate the five constraints and how they mediate teachers' beliefs and practices.

7.3.1.1 Absence of creativity assessment

There are no assessment criteria to measure students' creativity in Kuwait. Five teachers reported the absence of clear and official legislation that identifies and measures the creativity of students. "Unfortunately, there is no standard to measure creativity, and creative actions are not rewarded by marks to be included in the final score of the students. The final score depends only on exams" (A, Int. 2). According to Ali, the current assessment policy reduces students' creative endeavours because it developed "a particular system based on collecting marks through exams"; therefore, teachers' practices focus on "helping students pass exams" (A, Int. 2).

Teachers also reflected that the formal assessment is developed according to guidelines of the science mentorship department which determine the quantity of topics, types of questions, skills and information for the tests. For example, Jasser confirmed that "the guidelines have nothing to do with assessing creativity. So there is no guideline for measuring and grading creativity, and I do not have the freedom to use students' creativity as standard to assess them. It is a fundamental problem" (J, Int. 2). Another teacher explained that teachers' practices are not applied to foster students' creativity as science teachers cannot assign a target without an assessment process to measure this target.

> Most of the teachers do not focus too much on fostering creativity as a target because there is no mechanism or even assigned marks for assessing creativity in scientific subjects. Most of the questions on exams focus only on recalling the information. (S, Int. 2)

Mohammed went further, strongly criticizing this assessment system. He mentioned that the outcomes of such assessments negatively influenced students' abilities as the students have "a tendency to provide direct questions and answers. … The problem is the assessment system. It enables students to receive the information, then put this information on the exam paper. After that, they may even forget what they have learnt" (M, Int. 2). Therefore, teachers asked for new assessment and examination policies. "Some of the most important things are amending the assessment criteria for evaluating science teachers' practices and adding methods for assessing creativity" (S, Int. 2).

7.3.1.2 Heavy textbook content

All the teachers confirmed that the curriculum, especially science books, contain massive information and lessons. They are keen to follow the syllabus plan and rush to cover all the assigned lessons and information. Teachers expressed that "the curriculum is concerned with quantity instead of quality" (M, Int. 2). If they must deliver such thick materials on time, then "how is it possible to foster students' creativity?" (F, Int. 2). Fahed, for example, suggested that the content of science textbooks "should be reduced" (F, Int. 2).

Some teachers, like Fahed, found that reducing the content is a significant solution because it is only a matter of quantity. Jasser acknowledged that he is focusing on quantity; he aims to teach "the two science books on time in order to prepare the students for the exams". He believed that "if [he] focused on one book rather than two, [he] could apply more activities and really foster students' creativity in [his] classes" (J, Int. 2).

Ali also strongly criticized the thickness of the textbooks and stated that it "kills creativity" because it does not allow him to apply stimulating practices or the students to perform any creative actions. The time spent inside the class is used only for teaching topics that "are filled with information and details" (A, Int. 1). Salem pointed out:

> The textbook is very heavy in terms of information. We have a problem with time. For example, the teacher's guide offers you additional ideas and activities such as outdoor learning, self-learning, and teamwork activities, but the problem is that I cannot cover all these ideas as long as I have to finish thick textbooks. (S, Int. 2)

Hence, science teachers appeared to be restricted to a specific syllabus which the data analysis showed overlaps the constraint of the thick textbook. The data analysis revealed that teachers are following an inflexible and restricted syllabus in terms of time, topic, exams, and so on.

7.3.1.3 Restricted syllabus

Science teachers appeared to be stuck with short- and long-term plans that impose sequential steps on them. They revealed that this syllabus is inflexible; they have no choice to change or be flexible with it. Seven teachers stated that the existing syllabus is not in line with the quantity of the textbooks, thereby putting science teachers in a very bad situation. For example, Ali claimed that the heavy textbook load kills creativity; the curriculum plan is killing creativity as well.

> When the curriculum is restricted and distributed in advance, imposing a tight period of time to completely teach rich scientific topics, in this case, the teacher aims to finish all the lessons rather than fostering various skills among his students. Therefore, when there is a prepared plan that provides a particular time, particular topics, and official demands, this kills the creative endeavours inside the class. (A, Int. 2)

According to Ali, the current science syllabus kills creativity because it sets both targets and the way to "reach these targets through specific ways" (A, Int.2). Another teacher (Zayed) went further to say that "it is hard to find creative behaviour from students" because of such a restricted plan and orders from science mentors. He said the distributed hours according to the syllabus "for teaching the curriculum are really bad" and "appear inappropriate" (Z, Int. 2).

Furthermore, Fahed negatively referred to the inflexibility of such a schedule, noting that "there is a mistake" when the system threatens teachers about any "delay in the plan"; instead, he asked for some flexibility to handle the plan with respect to his students' needs and desires (F, Int. 2). Omar explicated that he does many "binding points" associated with scientific concepts, aims, lesson preparation, evaluation, and assessment. Like all science teachers, Omar felt it is hard to be flexible with these obligatory points, so he was "bound to the behests of [his] science mentor rather than [his] own desires" (O, Int. 2).

7.3.1.4 Lack of time

All the teachers acknowledged that they have very short and insufficient time. According to the teachers' responses, insufficient time appeared to be an overlapping constraint with the thickness of textbooks and restricted syllabus. During the fieldwork, I did not come across any teacher who claimed to have enough time; rather, most of them reported that they even work at home to manage the lack of time. Most teachers reflected on the current curriculum and stated that it suggests many activities to generally prompt higher thinking skills and creative actions. Nevertheless, they simultaneously raise the issue of time.

> To be honest, the science curriculum is developed and dramatically focuses on the development of higher thinking skills, but there is problem forcing teachers to care more about scientific concepts than high mental skills. For example, the available time is very short for teaching thick and rich topics. The class is only 45 minutes. (S, Int. 2)

Fahed shared a similar point of view. He agreed that the science curriculum suggests activities for stimulating different skills and abilities; however, he calculated the number of teaching hours to prove that it is insufficient.

> I have to teach almost 200 pages in three months and there are 4 sessions every week. So, I have 16 sessions per month and the semester consists of three months so … less than 50 sessions. Frankly, there is no time for applying the variety of

> activities suggested by the teacher’s guide. (F, Int. 2)

Given such limitations, Zayed indicated that students could “be creative through certain dialogues, when there is a discussion”. He claimed that students’ creativity in this case does not exceed or “go beyond verbal actions such as sharing new ideas or application. … Not more than this because the class time is very short” (Z, Int. 2).

7.3.1.5 Lack of resources

Six out of eight teachers indicated that lab equipment and resources are inadequate. Their classroom practices are negatively affected by such a deficiency. Jasser, Omar, and Zayed explained that the resources and lab materials are outdated and old. They declared that the available tools were in line with the previous curriculum; however, when the new curriculum and textbooks were assigned in 2010, most of the old tools were not replaced.

For example, Jasser felt that creativity in his class cannot emerge without updated tools and resources. He confirmed that the available equipment and tools “in the lab are old and outdated”. Notwithstanding, Jasser and his colleagues “used to use the smart board” to cope with this constraint (J, Int. 1). Zayed also spoke roughly about the lack of appropriate tools and equipment. He estimated that “90% of the existing equipment is based on previous syllabus and old textbooks” and added that “the current curriculum was applied almost 3 years ago, but [updated] resources and tools were not provided at the same time” (Z, Int. 2). Omar supported this idea as well.

> The current curriculum is excellent, but there are some drawbacks. For example, the supplies and equipment are not in line with the curriculum. All the equipment that I use is old tools dedicated to the previous curriculum. I mean … the current books have a lot of ideas to apply and support students’ creativity, but unfortunately I cannot [do them]. I need modern tools to fit such activities. (O, Int. 1)

Other teachers (Mohammed, Khalid, and Salem) believed that, to foster student’s creativity, they need more resources and materials than what the current curriculum offers, because fostering creativity means fostering something new and unexpected. Therefore, they expressed frustration that the current available resources do not meet their expectations and are not even enough to conduct different activities. For example, the limited tools force Salem to do group activities as it is difficult to "prepare and find tools for more than 24 students" (S, Int. 2). He "experiences daily challenges" to find enough sources and tools (S, Int. 2). Khalid further acknowledged that the ministry provides the needed and basic tools, but "some ideas cannot be adopted because of the lack of some equipment" (K, Int. 2).

7.3.2 Personal constraints

The findings revealed that certain constraints are directly related to the science teachers: feeling stressed, lacking knowledge about creativity issues, and controlling the classroom.

7.3.2.1 Feeling stressed and overloaded

Considerable evidence in the data indicated that seven teachers complained that they feel tired and stressed from the daily multiple tasks. They all reported that they experience too much stress to accomplish their work. Most teachers felt stressed from doing both teaching and administrative tasks. They believed that administrative tasks should not be their responsibilities. Fahed declared that "the teacher must take care of many things. Therefore, he is always under pressure". His responsibilities include "checking whether he is abiding with the syllabus plan or not". Fahed complained that teachers have "to cover all their administrative work and plan for their lessons at the same time" (F, Int. 2).

Such stress appeared to be an effective personal factor that negatively affects the teaching practices. For instance, science teachers report to many people, such as "the head of the department, the school principal, the science mentor and the administration staff. The teacher is busy and stressed all the time which really affects his performance" (O, Int. 2). Zayed felt that he is psychologically tired from having to do inappropriate administrative tasks since the beginning of the school year. "Some of them are bureaucratic and sometimes they are things that are irrelevant to the educational process which psychologically intimidates me" (Z, Int. 1). Salem also agreed with this opinion, but he was slightly optimistic because the Ministry of Education is going reduce the overload in order to have more comfortable teachers.

> There are some positive signs as the minister of education announced that starting next year, teachers will not be assigned any administrative loads. They will be completely free to perform their teaching tasks only. The teacher has 15 to 18 classes per week besides supervising specific classes. They are already loaded with many tasks to do (S, Int. 2).

7.3.2.2 Teacher's control

Five teachers mentioned teacher's control, stating that it could limit the applications of pedagogical approaches for fostering students' creativity. The participants indicated that teachers might prefer to control all activities themselves in order to prevent any type of chaotic behaviours. Salem, for example, stated that teachers use control to ensure "classroom discipline" which is "a priority" for him (S, Int. 2). Meanwhile, Jasser pointed out that poor control by the teacher "encourages the troublemaker to create disturbances" (J, Int. 2).

Such control leads teachers to apply dictation approaches and avoid the approaches that rely on students' participation and interactions. Omar and Mohammed discussed the matter of teachers' temptation to control their classrooms in depth. For instance, Omar stated:

> Some teachers find it difficult to control students when students are distributed into groups. It would be chaotic. But believe me, everything that is done for the first time is hard. The first time it would be chaotic, and then the second time the students get better, and the third time it becomes easy. (O, Int. 1)

He believed that this is a negative thought about controlling the classroom activities. He argued that control is not a preventative approach in which students can take a great part; rather, it requires being mentally prepared for the activities.

> A teacher who is not mentally prepared for a class is like a piece of log in the sea: It drifts with the waves that the students control. They control him. As for the teacher who is mentally prepared, he is the one who positively controls the students and moves them in whichever direction he desires. (O, Int. 1)

7.3.2.3 Outdated knowledge of creativity

The findings indicate that four out of eight teachers pointed out that possessing knowledge about creativity, including how to foster and assess it inside the classroom, is poor and out-dated. The teachers were constrained by their lack of knowledge of creativity. For example, Ali argued that teachers should possess "theoretical and practical information about issues related to creativity" (A, Int. 2). He believed that many teachers have not acquired information about creativity, so "they do not know how to foster it in their classes" (A, Int. 2). Similarly, Omar argued that teachers should be knowledgeable about creativity in the first place; they need to be trained about it and "know how to foster creativity in an optimal way" (O, Int. 2).

> The teacher cannot foster something without knowing all issues related to this particular thing. And do not forget that there are teachers who have been in service for a long time. They are not open to the latest information about creativity. ... A real example, we have asked to use technology to make a communication circle among teachers, parents, and students. So the ministry designed a website called E-square. The problem is that senior teachers are not very knowledgeable of IT and they struggle to communicate with parents. (O, Int. 2)

Another teacher discussed the lack of teacher knowledge and stated that teachers have "out-dated knowledge about teaching and learning in general" (M, Int. 2). Mohammed believed that this lack stems from two factors. One is personal, when the teacher himself "does not make any endeavours to gain knowledge" about the latest educational information and approaches. The second factor is "the Ministry of Education does not offer enough professional training programmes for teachers" (M, Int. 2).

Salem also stated that “not all science teachers have studied topics associated with creativity, so many of them do not know how to develop creative works” (S, Int. 2). Overall, it appeared that poor professional knowledge related to fostering creativity is a constraint that prevents teachers from putting their pedagogical beliefs into practice.

7.3.3 Interpersonal constraints

Interpersonal constraints refer to the impact of the individuals around the teacher, such as students, parents, educators, and professionals in the science field. Four themes emerged as interpersonal constraints: disruptive behaviours inside the classroom, parental attitude toward education, lack of professional training, and weak relationship with experienced institutions.

7.3.3.1 Disruptive behaviours

The data showed an unexpected constraint—namely, disruptive behaviours from troublemakers. Five teachers believed that offering free space for students could be negatively used by careless students creating “rowdiness and chaos in the classroom” (K, Int. 2). Teachers stated that the whole lesson could be ruined when few students have the chance to do so.

> The behaviours of some students prevent me from addressing students’ creativity. Of course… the chaos does not come from all students; rather, the majority of students are polite and respectful. But a few students are troublemakers, and they look for any opportunity to do so. (Z, Int. 2)

According to Omar, the disturbances created by these students makes the choice of applying student-centred approaches less preferable for many teachers. He pointed out in his first interview that “teachers avoid applying group work or any cooperative learning” to prevent any kind of chaos (O, Int. 1). In his second interview, he was convinced that most of the teachers apply teacher-centred practices because they are “a way of controlling the students inside the class and delivering the lesson” (O, Int. 2).

> Some of the students can be badly affected by the behaviour of some careless students; and [these kinds of behaviours] hinder students' creativity. … Such behaviour influences me in terms of the way that I control negative behaviours, and that affects the approach and the objectives of the lesson as well. (O, Int. 1)

Thus, Omar stated that teachers seek to create disciplined classrooms to prevent any misbehaviours. Salem also insisted that discipline is essential; otherwise, fostering students' creativity will be limited due to disturbances from careless students.

> Discipline in the classroom is important because, without it, the troublemakers will take the opportunity to raise the inconvenience which causes a disturbance in the class. It causes a lack of focus on the class questions and the subject. Even is students are fully attentive, a few students who engage in some riots lead to fuss, and of course it will reduce creativity in the classroom. (S, Int. 2)

7.3.3.2 Parental attitude toward education

Five teachers raised another interpersonal constraint: parents' focus on passing exams rather than developing their children's skills. Teachers claimed that the majority of parents seek high scores for their children. Moreover, they are not keen to encourage their children to participate in activities that do not have a positive impact on their children's scores; rather, parents place the priority on exams. Such a parental attitude, according to Omar, could directly affect his pedagogical practices because if the parents had a positive attitude toward fostering creativity, their children would be prepared mentally and psychologically:

> As a result, it enables me to raise the classroom level and focus on activities that help the student develop his abilities to innovate and vice versa…. If there is no interest from the parents' side, I am compelled to decrease the level of performance. (O, Int. 2)

Similarly, Fahed stated that "parental attitudes affect students' creativity" (F, Int. 2). Fahed also expressed that passing exams and obtaining good scores are the most important goals for parents;

thus, they are more likely to focus on factual information that will be included on the exam.

Another teacher pointed out an example of extracurricular activities that concerned fostering skills and abilities when he said these activities “are not mandatory and do not count as a scores on students’ grades. So students and their parents ignore the participation in such activities” (S, Int. 2). As Ali said, “few parents motivate their children to participate in these activities. Unfortunately, the majority of parents aim for their children to gain good scores only” (A, Int. 2).

Interestingly, Mohammed talked about himself as a parent and commented that, “even when we as parents teach our children, for example, we advise them to study hard to succeed and to do the homework to succeed”. He added “we only care that our children are studying in order to be prepared for exams and to pass the class” (M, Int. 2). Therefore, teachers argued that the current parental attitudes must be changed; parents should follow-up with their children in terms of the development of different abilities and skills, including creativity.

7.3.3.3 Lack of professional training

Attending courses and workshops “specializing in teaching and fostering creativity and innovation” appeared to be a rare opportunity for teachers, as most of the courses provided by the Ministry of Education “are not specialized in this field” (J, Int. 2). Five teachers expressed their concerns regarding teachers’ experience with respect to creativity and advanced pedagogies. They revealed that training workshops related to fostering creativity are insufficient. As a result, “there is weakness in the professional development of science teachers” (F, Int. 2).

The teachers argued that fostering creativity requires advanced training workshops. They believed that the current training workshops are unsatisfactory. Mohammed called for enrolling teachers in “intensive courses focused on advanced teaching methods” (M, Int. 2) to make the teachers aware of “the latest educational methods and tools. Also, the teachers must keep updated with new technology, especially technology related to science education” (Z, Int.2).

Salem shared a similar point of view. He found that the current in-service training courses have poor content in terms of the latest pedagogical activities and how to build up the creative classroom. He thought that exchanging experiences with other advanced institutions concerned with creativity could increase science teachers' professional development. Salem also believed that the workshops and in-service training should be based on "the exchange of ideas and experiences among educators and teachers" (S, Int. 2).

Furthermore, Ali declared that teachers should be trained to know how to foster creativity. They should receive theoretical and practical information about creativity. It is a priority for him to educate teachers about the meaning of creativity, how to identify its aspects, how to apply fostering approaches, and how to have assessment criteria for creativity. Notwithstanding, Ali felt ashamed that such priorities are neglected: "Unfortunately the specialized workshops are very few in number. I think it is essential that teachers enrol in workshops about students' creativity, how to provide the opportunities, and how to motivate them to be creative" (A, Int. 2).

Overall, poor training on how to encourage creativity appeared to be constraint. "Workshops on pedagogical practices that release the creative energies of students are absent" (F, Int. 2). Teachers who referred to this constraint called for more specialized and intensive training workshops and regular seminars to exchange ideas and experiences.

7.3.3.4 Weak links with experienced institutions

The gap between schools' science departments and relevant associations in society was noted by six teachers. They stated that it is regrettable to find that there are no programmed outdoor activities or exchange experiences with other relevant associations. Such a gap is considered to be a constraint because teachers believed that associations (e.g., Kuwaiti Scientific Club, the Institute of Scientific Research, and the Center of Sabah for Creativity) are advanced and have valuable experience in terms of fostering creative and innovative youth in the science field.

Fahed, Jasser, Salem, and Omar expressed that they interacted with external associations on limited occasions when teachers on their own initiate and communicate with them. For example, Fahed used to arrange "combined activities" with scientific and educational associations, yet these organizations do not “share their experiences and knowledge unless teachers ask them to” (F, Int. 2). During the fieldwork, I noticed that science teachers admired such organizations because “they have experienced instructors and professionals who are supervising creative young people on a daily basis. Hence, [science teachers] need to import methods and strategies from these organizations to foster students’ creativity in their schools” (S, Int. 2). Another teacher mentioned that science teachers are excluded in their schools; even when scientific institutions play a role, it is limited.

> [These institutions] endorse many activities that serve scientific creativity. But I don’t see any interfering or cooperation. I don’t see any enterprise coming from their side to foster creativity in schools. But to be frank, these institutions are sponsoring scientific creativity and are developing ideas, projects, and innovations of young people to practically conduct them. (A, Int. 2)

According to Ali, the role of institutions must be greater than this as “they should share and convey their experience to schools and science teachers in particular” (A, Int. 2). Mohammed and Omar held similar sentiments and called for permanent coordination and a clearly concerted programme between these institutions and the Ministry of Education. “The relationship must be built through an educational programme and a clear educational policy to cooperate with the relevant institutions” (M, Int. 2). Overall, the teachers found that being isolated from experienced institutions prevents them from being updated with the most effective approach to fostering students’ creativity.

7.4 Summary

This chapter’s two sections aimed to answer the third and fourth research questions. First, the science teachers’ pedagogical practices were presented through three major themes: goals of teaching and learning, actual classroom practices, and extracurricular practices. Two goals of teaching and learning were identified, and both teachers and their students shared the goal of understanding scientific information to pass school examinations. In the second major theme, the study revealed that science teachers apply both student-centred and teacher-centred approaches in their classes; however, it also revealed the student-centred approaches such as group work, dialogues, experimentations, and guided enquiries were insufficiently applied whereas teacher-centred approaches such as lecturing and using ICT for teachers' presentations were strongly evident across the cases. The third part of this section highlighted the teachers' practices within extracurricular activities; the teachers claimed that extracurricular approaches such as open enquiry competitions, scientific trips, and science teams foster creativity. However, such activities are not compulsory, so not all the students benefit from these approaches.

Second, the chapter discussed the sociocultural factors that mediate teachers' beliefs and practices. The teachers pointed out several constraints that can be classified under three major categories: external, personal, and interpersonal constraints. Five external constraints were identified: lack of time, restricted syllabus, thick textbook content, lack of resources, and absence of creativity assessment. Personal constraints including a lack of knowledge about creativity, teachers feeling stressed, and teachers' control. Finally, interpersonal constraints included disruptive student behaviours, parental attitude toward education, lack of professional training, and weak links with experienced institutions.

Chapter Eight: Consistency and Inconsistency Levels (case study findings)

8.1 Introduction

The findings in Chapters 6 and 7 answered four questions of this study. The aim of the current chapter is to illustrate consistencies and inconsistencies between teachers' beliefs and practices in order to answer the last question: How consistent are science teacher's practices with their beliefs?

In order to explore the relationship between beliefs and practices, this chapter moves from providing thematic findings to case studies findings. This aim is achieved by individually exploring the case studies. Throughout the analysis, the eight cases are classified into four groups according to the consistency level between creativity-fostering beliefs and practices.

Thus, the structure of the current chapter begins with a section that illustrates the process of case classification and reveals the consistency level in each case. It also, identifies the four emerging groups. The second section discusses four exemplary cases of the groups, in which each case represents a particular relationship between beliefs and practices.

8.2 Levels of consistencies and inconsistencies

In this section, the classification process is discussed in order to explain and justify the emergent levels of consistencies and inconsistencies. Accordingly, this section starts with an analysis of the data by adopting the cut-off point technique to measure levels. The discussion then reveals the results of this analytical process in terms of the teachers' beliefs as well as their practices. Finally, the section ends with a demonstration of the beliefs–practices level within each case, followed by exemplary cases at each emergent level.

8.2.1Cut-off point as an analytical tool

As the consistency level can be diverse among the cases, and it is hard to categorize a particular case as purely consistent or inconsistent, a cut-off point is needed to distinguish the eight cases according to the consistency level. Two recent studies adopted a cut-off point for similar purposes. Alnesyan (2012) classified seven cases through the cut-off point process in order to define cases that foster thinking skills (progressive cases) and cases that do not foster thinking skills (traditional cases). He used 66% as the cut-off point, where 66% or more indicates progressive cases, 33% to 66% indicates mixed cases, and 33% or less indicates traditional cases. More recently, Mansour (2013) classified 10 teachers from a previous study into cases according to the relationship between beliefs and practices. He studied the consistency between beliefs and practices, and used a cut-off point to define traditional, mixed, and constructivist beliefs and practices within the 10 cases.

Therefore, I adopted the cut-off point technique to differentiate among different beliefs as well as practices. More precisely, if a teacher's beliefs or practices scored 40% or less, they were coded as non-creativity-fostering (traditional) beliefs or practices. If a teacher's beliefs or practices scored between 40% and 60%, they were coded as mixed beliefs or practices. Finally, if the score for the teacher's beliefs or practices was 60% or more, they were coded as creativity-fostering (progressive) beliefs or practices. This process could create up to nine levels of relationships between beliefs and practices to describe the consistency level.

Five standards were used to classify both teachers' beliefs and practices, and the teacher's scores within the five standards determined the overall scores of beliefs as well as overall scores of practices. The five standards in the thematic findings are: 1) meaning of creativity; 2) teaching for creativity; 3) creative learning; 4) teacher's role; and 5) student's role.

The next step after the classification process is the validation of this analysis process, during which other standards are adopted to check the validity of the analysis process. The current study embraced the creativity-fostering teacher framework developed by Cropley (2001) to validate the classification process. Cropley listed several features of creativity-fostering teachers. These features can be used to measure each teacher's beliefs and practices.

1. Encourage students to learn independently.
2. Use a cooperative, socially integrative style of teaching.
3. Motivate the students to master factual knowledge to possess a solid base for creative thinking.
4. Promote self-evaluation in students.
5. Encourage flexible thinking.
6. Interact with students' questions seriously.
7. Offer opportunities for the students to deal with different situations.
8. Help students cope with frustration to be able to generate unusual ideas.

8.2.2 Consistency and inconsistency levels

The findings of the analysis revealed that the eight teachers can be categorized into four groups, which each group representing a particular degree of consistency between creativity-fostering beliefs and practices. In terms of beliefs, the teachers held traditional (non-creativity fostering) beliefs (Jasser), mixed beliefs (Mohammed, Zayed, and Omar), and progressive (creativity-fostering) beliefs (Khalid, Fahed, Salem, and Ali); further details about the belief's classification are provided in Appendix (K). Teachers practices' were categorized according to traditional (non-creativity fostering) practices (Jasser, Mohammed, and Zayed) and mixed practices (Omar, Khalid, Salem, Ali, and Fahed); further details about the practice's classification are provided in Appendix (L). Before moving on to the four emerging groups, a brief description of each type of belief and practice is provided.

8.2.2.1 Classifications of teachers' beliefs

With respect of the three levels of teacher beliefs, traditional beliefs are held by Jasser only, who did not meet most of the creativity-fostering features developed by Cropley (2001). For example, Jasser indicated that the teacher is completely responsible for both teaching and learning; he supported the lecturing approach and stated that he learnt this way. He also held traditional beliefs about creative people, believing that they are gifted and should be taught in special schools.

Three teachers (Mohammed, Zayed, and Omar) held mixed beliefs; they believed in some features of the traditional (non-creativity-fostering) perspective as well as the progressive (creativity-fostering) perspective. Therefore, they combined mixed beliefs.

Finally, four teachers held progressive (creativity-fostering) beliefs (Khalid, Salem, Ali, and Fahed), as they scored above 60% with regard to the features of creativity-fostering teachers. For instance, the teachers believed that teaching and learning should be based on students' interests and address their areas of curiosity. Student-centred approaches were strongly supported; the four teachers indicated that differentiating teaching approaches is necessary while avoiding efforts to control students' actions by being authoritarian teachers. They also believed in creativity for all by acknowledging that everyone has creative potential. Thy believed that inquiry-based learning and cooperative learning are effective approaches for fostering students' creativity in the science classroom.

8.2.2.2 Classifications of teachers' practices

The classification of practices leads to two levels: traditional and mixed. Three teachers adopted traditional non-creativity-fostering practices compared to five who adopted mixed practices. Jasser, Mohammed, and Zayed were traditional in their classrooms. Their classroom activities were based on teacher-centred approaches. The students were silent most of the time and did not speak until they received the teacher's permission. The direct transmission of information was evident in their classes. The lecturing approach also was frequently observed, and the teachers did most of the talking. The teachers' main focus was to prepare students to pass school examinations, so they repeatedly referred to possible questions that could be included on the exams.

Meanwhile, five teachers (Omar, Khalid, Salem, Ali, and Fahed) were situated between traditional and creativity-fostering practices, resulting in mixed practices (40% to 60%). Their classroom practices combined teacher-centred and student-centred approaches. Activities such as practical, group work, and dialogues were used as well as direct transmission activities such as lectures and data presented via ICT devices.

Interestingly, none of the teachers were classified as creativity-fostering teachers with regard to their practices, indicating that there is no case to consider as purely progressive (i.e., possesses creativity-fostering beliefs and practices).

As illustrated in Figure 16, the eight cases represent four groups, with each group representing a specific level of the belief–practice relationship. The four groups are further discussed through the exemplary cases.

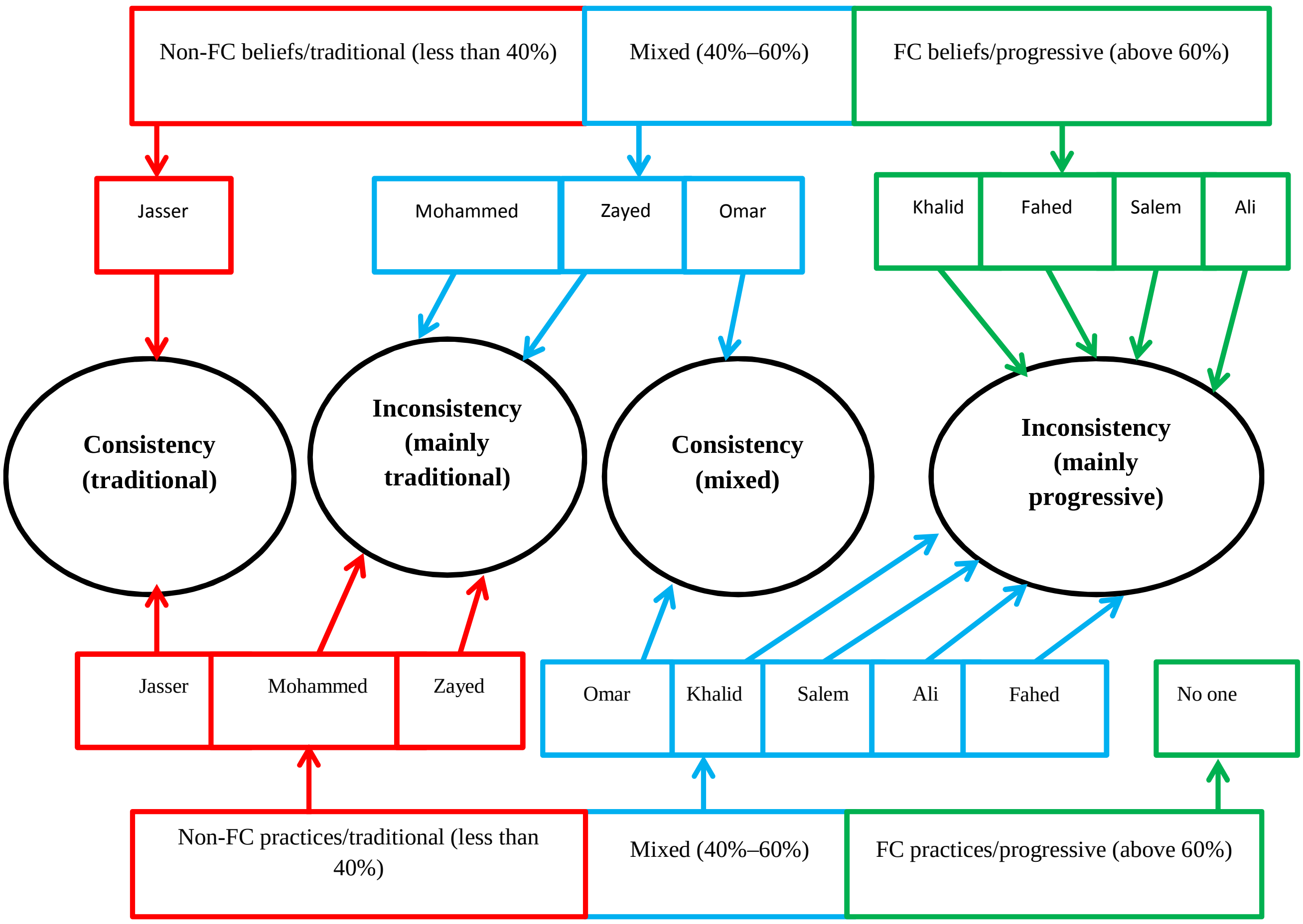


Figure 16: Consistent and inconsistent groups

- ***Traditional (non-creativity fostering) group****:* Teachers held traditional beliefs, which are consistent with their traditional practices. Only one teacher was included in this group (Jasser). Thus, Jasser is the exemplary case of this group.

- ***Mainly traditional group:*** This group comprises teachers who held mixed beliefs, but their practices were traditional. Consequently, inconsistency is evident between beliefs and practices. Of the two teachers in this group (i.e., Mohammed, and Zayed), Mohammed offered richer data than Zayed and was aware of many contextual issues; therefore, Mohammed is used as the exemplary case of the mainly traditional group.

- ***Mixed group:*** this group refers to teachers who held mixed beliefs and mixed practices, creating a consistency level between beliefs and practices. Omar was the only teacher assigned to this group. Thus, Omar is the exemplary case of this group.

- ***Mainly progressive group:*** This refers to teachers who held progressive (creativity-fostering) beliefs, but applied mixed practices. Inconsistency is evident between belief and practices. This group comprises half of the teachers (Khaled, Salem, Ali, and Fahed). I chose Khalid as the exemplary case of this group because he offered rich data and was a more extroverted teacher than the other three teachers.

The findings of each exemplary case study are illustrated using five major themes: 1) contexts of the case (personal/ academic/professional/classroom/school/science mentorship/societal); 2) complementary role of the teacher and students; 3) creative learning in the science classroom; 4) teaching creativity in the science classroom; and 5) a reflection on the case.

8.3 Jasser (Consistent, traditional case)

8.3.1 Contexts

- **Personal context**

Jasser is the youngest teacher in the science department. He is a 25-year-old single man who lives with his parents. He appeared to be introverted and shy; he does not regularly engage with colleagues' discussions and conversations about either professional issues or daily life issues. During the fieldwork with Jasser, he was always cool and calm; even his voice pitch was always stable and invariant. I noticed that he was less energetic than his colleagues within the science department.

- **Professional–academic context**

Jasser obtained his bachelor's degree in science education in 2007; he specializes in teaching physics. As the youngest of the six teachers in the science department, he has not worked as a teacher at other schools. He has four years of teaching experience, during which time he has taught sixth, seventh, and eighth grades. He has not taught ninth grade as the head of science department prefers to assign senior teachers to this grade. Jasser has only attended one workshop provided by the Ministry of Education for prospective teachers. During his education, he did not study any module related to creativity in education. Thus, his teaching approaches depend on his "former schooling experiences as a student"; as he explained, "I teach science in the same way that my former teachers taught me" (J, Int. 1). Jasser appeared to be textbook-oriented, and his target was to follow the syllabus plan and deliver the information addressed in the science textbooks.

- **Classroom context**

During the fieldwork, Jasser taught five classes: two seventh-grade classes and three sixth-grade classes. I focused on one of his seventh-grade classes, which comprised 25 students. Although there are two science laboratories in Jasser's school, the observed lessons were taught in the original classroom. He justified this by saying "moving from the original classroom to the laboratory takes a few minutes, so my aim is to save time" (J, Int. 2).

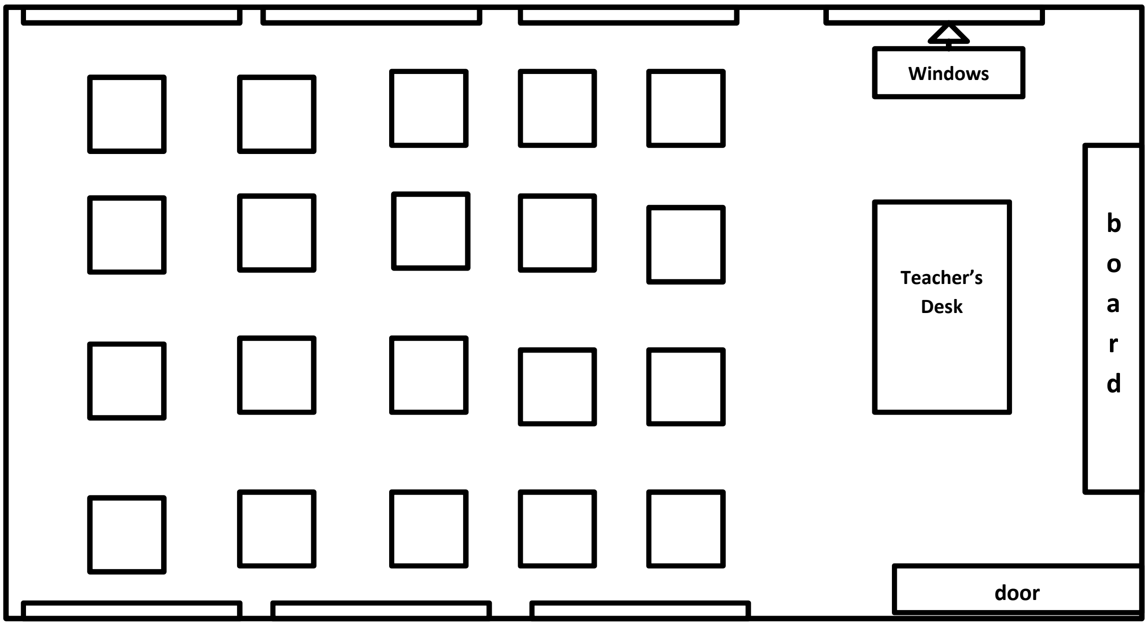


Figure 17: Physical layout of the original classroom in Jasser's school

Large windows provide appropriate lighting, and the classroom benefits from central air conditioning. The students' desks are arranged in rows facing the teacher's desk and the white board. The structure of the class does not support cooperative activities in groups or pairs. Also, it is inappropriate for conducting experimental activities. Thus, Jasser teaches in the laboratory "only when there is experimental activity" (J, Int. 2). Among the eight cases, Jasser was the only teacher who preferred to teach in the classroom rather than the laboratories.

- **School and science mentorship context**

The school was established in 1988; the current 450 students are distributed into 21 classrooms. There are 72 teachers and 13 departments, with each department focusing on a specific subject. The subjects are divided into two categories: those that affect the student's final assessment report (i.e., science, math, humanities, Arabic, English, Islamic education, and computer science) and those that do not affect the final assessment report (sports, music, interior designing, art, and electricity). The school management consists of a principal, two principal assistants, a social worker, a psychologist, and other employees.

The central interests of the school management enable students to pass school examinations while keeping in line with the ministry's syllabus, maintaining disciplines, and preventing students' disturbing behaviours. Hence, Jasser follows the orders of both his science mentor and the school principal. He stated that "they want me to focus on exams and follow the annual plan, while the time is short … in this case, it is better to focus only on the information of the textbook because the exam questions are derived from the textbook" (J, Int. 1). In addition, Jasser did not prefer to encourage student-centred approaches inside the classroom because "misbehaving students will take the chance to create problems", and then "school management will think that I cannot maintain discipline" (J, Int. 1). He was keen to prevent any disruptive behaviour to avoid being accused by the school management of not being able to manage his classes.

- **Societal context**

According to Jasser, the Kuwaiti community—especially parents—do not focus on their children's creativity, or it does not seem to be their first concern. By contrast, people want their children to succeed in their studies and be high achievers. As he said, "students here [in Kuwait] come to school for the sake of gaining marks and holding certificates" (J, Int. 1). Thus, he thought such parental demands do not support teachers' endeavours to foster creativity within their classrooms because parents are not going to look at their children's creative ability; rather, they look at the annual and semester reports for their children and how high their scores are on exams.

8.3.2 Complementary role of the teacher and students

Jasser held a traditional view about creative students, distinguishing as being different than others because they are gifted. He believed that creative students should be placed in a special programme to receive the appropriate education. When asked to define creativity, he stated that "it is … a person or student who, for instance, responds unlike all the other students or unlike the ordinary ones" (J, Int. 1). Jasser also strongly believes that "most of the excellent students are somewhat creative" (J, Int. 1). He confirmed that excellent students are creative. Nevertheless, he was the only teacher who believed in this statement. Thus, he preferred to say excellent students and underachievers. For example, he stated that his role is to pose competitive questions for the students according to their abilities.

> I should always prepare a question for the low-grade students as well as for excellent students. This is to help excellent students feel that the questions that are being asked are of their same level of excellence. Also, they would feel bored if the questions were far below their abilities, and then eventually start despising the class. (J, Int. 1)

In the second interview, Jasser claimed that the majority of students are concerned with being successful students rather than creative ones. He stated that the majority tries to apprehend the content of science topics "to correctly answer the test questions. Here, the student attends classes for the sake of marks. I mean passing exams is the highest concern" (J, Int. 2). Jasser's statement was in line with what his students said in the focus group: Students found that marking their participation is an encouraging action because they can collect marks for their final certification. For example, student Fathel said:

> I mean when we finish a lesson, then the teacher sets the oral test and puts a mark for us. It forces every student to study and grasp the lesson. Then, when the students complete the paper exam, they will remember the oral test and information. So they can provide perfect answers. (J, FG, St.Fathel)

Overall, passing exams was a clear goal for both Jasser and his students, so that both of them played the roles to serve this goal because "the results of the students' exams not only represents the students' abilities, but also the teaching ability of their teacher" (J, Int. 2).

8.3.3 Creative learning in the science classroom

Jasser was optimistic about cooperative and independent learning. He spoke about the beneficial outcomes of such learning styles on students' creativity. Jasser alleged that cooperative learning provides a space for generating and refining students' thoughts. In group work activities, for example, "each member of the group participates and talks with his peers to draw one agreed-upon conclusion". He felt that "students become more comfortable sharing their ideas and expectations with peers" (J, Int. 1). Jasser also referred to independent learning and asserted that students interested in science have a lot of questions about specific issues. They usually "look up topics on the internet and obtain more comprehensive information on to the topic. They would have questions and would ask many deep questions according to their searches" (J, Int. 1). Therefore, Jasser felt that encouraging students to be independent is an appropriate learning style to meet students' passion for answering their questions. He explained how to deal with students' questions through guided inquiry, saying:

> I can tell them to go home and search for a particular topic using the internet and secondary resources, such as visiting a location related to the topic, asking parents, asking siblings, or asking me a specific question. Then, I … ask them to write about this particular topic. If the students are interested in the topic, I will definitely get creative answers and reports…. (J, Int. 1)

However, Jasser believed that cooperative and independent learning styles are not beneficial for ordinary classes as he held traditional beliefs that creative students should be taught in special schools or special classes, because they are gifted and more able students. Furthermore, he named different reasons to justify teacher-centred learning instead of creative learning such as avoiding time consumption, controlling disruptive behaviours, and covering textbook content. For example, he found that activities for fostering creativity "may not be achieved in one session…. It could take one week to complete it [and] consume a lot of time, such as learning-based inquiry" (J, Int. 1). Jasser acknowledged that one of the obstacles he faces when he attempts to encourage student-centred learning is the irresponsible behaviours and lack of students' interest. He declared that "the lack of interest from students and their irresponsible freedom during the classroom activity are annoying and cause hindrances... I mean [their] lack of interest and negative behaviours obstruct other peers' performance in a very effective way" (J, Int. 2).

Therefore, Jasser represented the traditional case as his non-creativity-fostering beliefs are in line with his instructional practices. My observations revealed that Jasser is a controlling teacher; his students have no role to play in terms of constructing learning activities or sharing their ideas. The learning process was teacher-centred, and the students learned through direct transmission of knowledge. All the observed lessons were directly delivered by Jasser; meanwhile, the students remained silent most of the time and appeared to be dependent learners. The students only spoke when Jasser asked them questions to check their understanding of textbook information. For example, Jasser used to pose review questions at the beginning and end of each lesson. He started by assessing students' understanding of the previous information and concluded his class using an oral test to examine students' understanding of the day's lesson. In one of his observed lessons, he spent the final 15 minutes emphasizing and checking the main concepts (J, Obs.2). When I investigated this point further by asking the students about the most familiar classroom practice that their teacher does every time, two students stressed that Jasser used to:

> **Essa:** Review the previous lesson before starting the new one.
>
> **Samir:** When we have a new lesson, we review the previous information to maintain–
>
> **Essa:** –we highlight–
>
> **Samir:** –to maintain the information and concepts.
>
> **Essa:** We highlight the important information and check it. (J, St. FG)

Later, during my second interview with Jasser, I asked him if he paid much attention to students' understanding of information during his teaching. His answer was that "the priority goes for scientific concepts that should be learnt and understood by students" (J, Int. 2).

Overall, it was evident that Jasser is textbook-oriented and focuses on monthly and final examinations. He was concerned with the challenges and negative outcomes of adopting cooperative and independent learning; hence, he supported applying teacher-centred learning in his class to limit constraints and achieve his orientations.

8.3.4 Teaching creativity in the science classroom

Two pedagogical approaches were discussed in this case: conducting experimental activities and lecturing. Jasser's beliefs and practices in term of teaching were non-creativity fostering. For example, despite the fact that he acknowledged the significance of allowing the students to conduct experimental activities on their creative thinking and skills, he preferred to apply scientific and practical demonstrations himself. He believed that students become motivated to set their presumptions and possibilities, then test them by conducting experiments for the sake of deducting new conclusions.

> Students can generate answers that are beyond their level of education. You can notice this when they conduct scientific experiments…. The students start by coming up with possibilities and probable conclusions. Then they get to find out which of their answers is correct through the experiment. (J, Int. 1)

Notwithstanding, Jasser stated that the “teacher doing the practical activity himself is more common than students doing it” (J, Int. 2). Practical activities were limited to some lessons in which the experiments are assigned to be included in the final practical test. None of the observed lessons included students’ experiments.

Thus, I asked the students about their view of applying experimental activities. One student responded that “we sometimes conduct interesting activities such as practical experiments and observations. It makes us creative”. Then, I asked him to offer an example of a practical activity he did. He said “the comparison of clay and sand. I touched, observed, and recorded the duration of absorbing the water. I thought of new ideas to compare the two [substances] …” (J, FG, St.Fathel). He also drew himself doing a scientific experiment and wrote “when the student does the experiment by himself, it helps him understand the lesson and helps him be creative”.

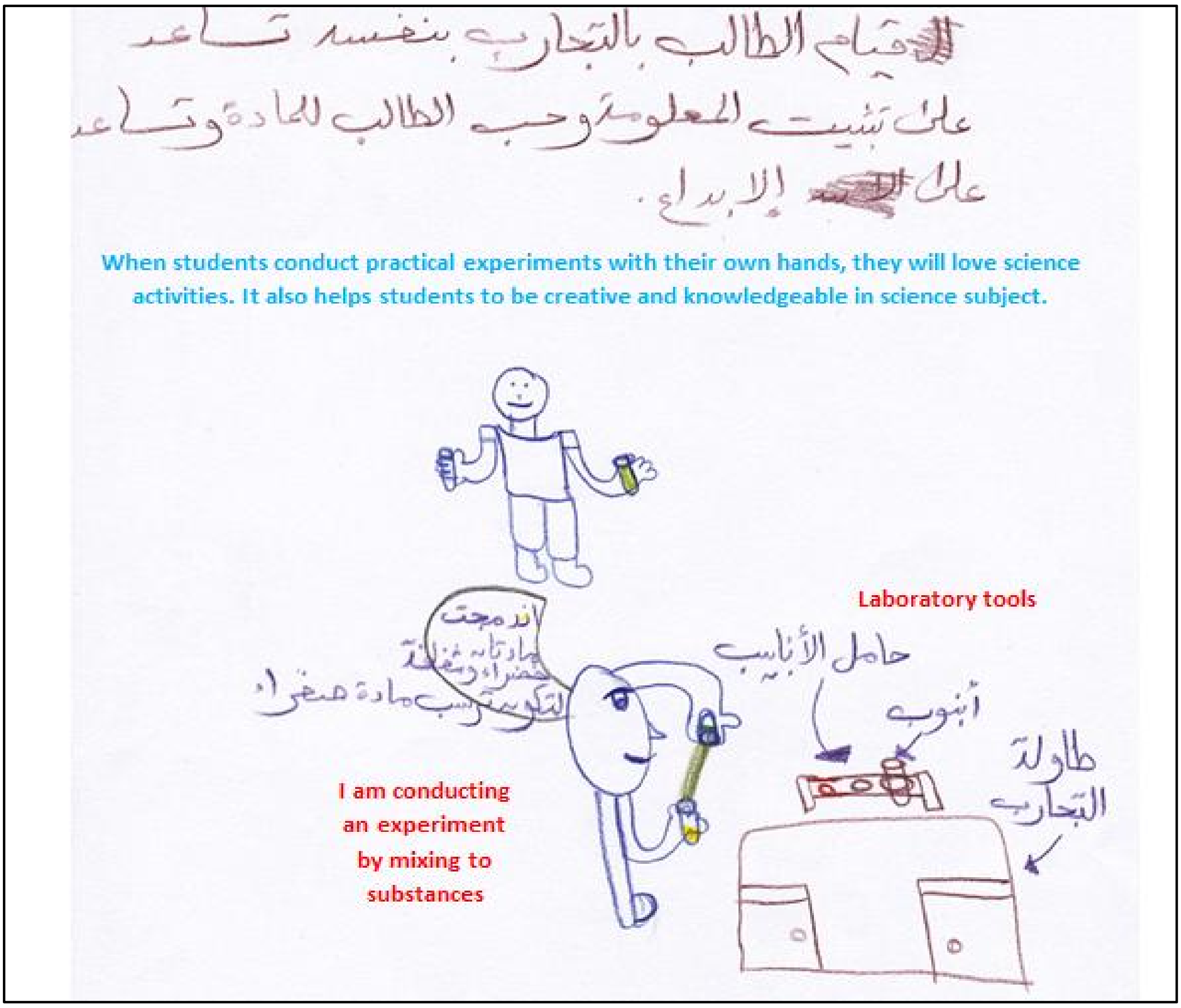


Figure 18: Student's drawing (J, FG, St.Fathel)

However, the observed lessons were clearly teacher-centred and far from enabling students to do practical activities to discover and conclude what they learn in their own. In contrast, Jasser was the source of information and knowledge inside his class while his students were recipients. Thus, in the second interview with Jasser, I revealed my observations, seeking for further illustration regarding the reasons of not enabling the students to do practical activities on their own. He said that "preparing tools and substances for all students takes a lot of time. And when they start conducting an experiment, the class becomes very annoying and inconvenient" (J, Int. 2). He added "there are other reasons of neglecting this practice. The session is only 45 minutes and the content is very rich; sometimes the school bell rings and the session ends before I finish my classroom activities and deliver the lesson's information" (J, Int. 2).

Therefore, most of the teaching was done through the lecturing style, where Jasser used to speak and present information to his silent students. His lectures incorporated either practical demonstrates or PowerPoint slides. He was aware that lecturing would not lead to creative performance, even though the direct transmission of knowledge through lecturing was the dominant approach in Jasser's class. For example, he stated contradictory statements before and after the observations. In his first interview, he strongly confirmed that "activities that rely on dictation and lecturing are not useful. I think lecturing is not a beneficial approach in science" (J, Int. 1). After four observed lessons, I asked Jasser about the use of dictation and lecturing, and his response was that "dictation has some positive features" (J, Int. 2). He admitted that he gives lectures and justified this approach by saying "one of it is advantages is the student can grasp the scientific concepts and memorize the information and the main concepts of the lesson" (J, Int. 2). However, being quite frank, Jasser added that the reason of applying such an approach is due to "the vastness of the subject's content and the considerable amount of information" assigned to be taught to the students (J, Int. 2).

> As a result, there is no time for accumulated tasks and activities. And, [science teachers] need to do several things in 45 minutes, such as reviewing the previous lesson, discussing the homework, explaining and teaching a new lesson, and then [they] want to assess the students' understanding. These accumulations should be done in a short time … which is why I abandon practices for encouraging the students' higher abilities and creative thinking skills. (J, Int. 2)

8.3.5 Reflection on Jasser's case

This case represents a non-creativity-fostering teacher in which there is a match between the teacher's beliefs and practices. Jasser held a narrow and traditional understanding of creativity. Although he named some approaches to foster students' creativity, he declared that these approaches need to be applied in special programmes for creative and gifted students; meanwhile, applying such approaches in the mainstream classroom could lead to contextual difficulties and undesirable outcomes. Clearly, Jasser was not enthusiastic about fostering creativity in his classes. He aimed to avoid challenges and limit constraints. Therefore, he appeared to be a textbook-oriented teacher who mainly applied teacher-centred learning activities to directly deliver information and prepare his students to do well on exams.

8.4 Mohammed (Inconsistent, mainly traditional case)

8.4.1 Contexts

- **Personal context**

Mohammed is 39 years old. He is married, and his wife is a senior primary teacher. Mohammed has five children, who are his first concern. Interestingly, although both Mohammed and his wife are senior teachers, they were keen to register their children in private schools at their own expense rather than in governmental schools which are free of charge. Therefore, a considerable amount of Mohammed's monthly salary is used for his children's education in private schools. This decision stemmed from the fact that Mohammed held a pessimistic perspective of the quality of teaching and learning in governmental schools.

- **Professional–academic context**

Mohammed graduated from Basic Education College in 1994. He has a bachelor's degree in science and math education. He has extensive experience, with more than 16 years of teaching in primary and then intermediate schools. In the first seven years, he taught students in primary school. He then moved to another school to teach intermediate students because of the lack of science teachers at the intermediate level. Mohammed is the head teacher of the science department; he is responsible for supervising the other science teachers. Therefore, he has to do more administrative tasks than other science teachers in his department. In terms of training courses, Mohammed has attended many professional workshops and in-service training courses.

- **Classroom context**

Most science teachers have to teach more than 15 sessions per week, but Mohammed teaches 8 sessions per week because his is the head of the science department and has other tasks to do. During the fieldwork, he was teaching two seventh-grade classes. I focused on one of his classes and observed it four times in different sessions. Mohammed used to teach in laboratory B.

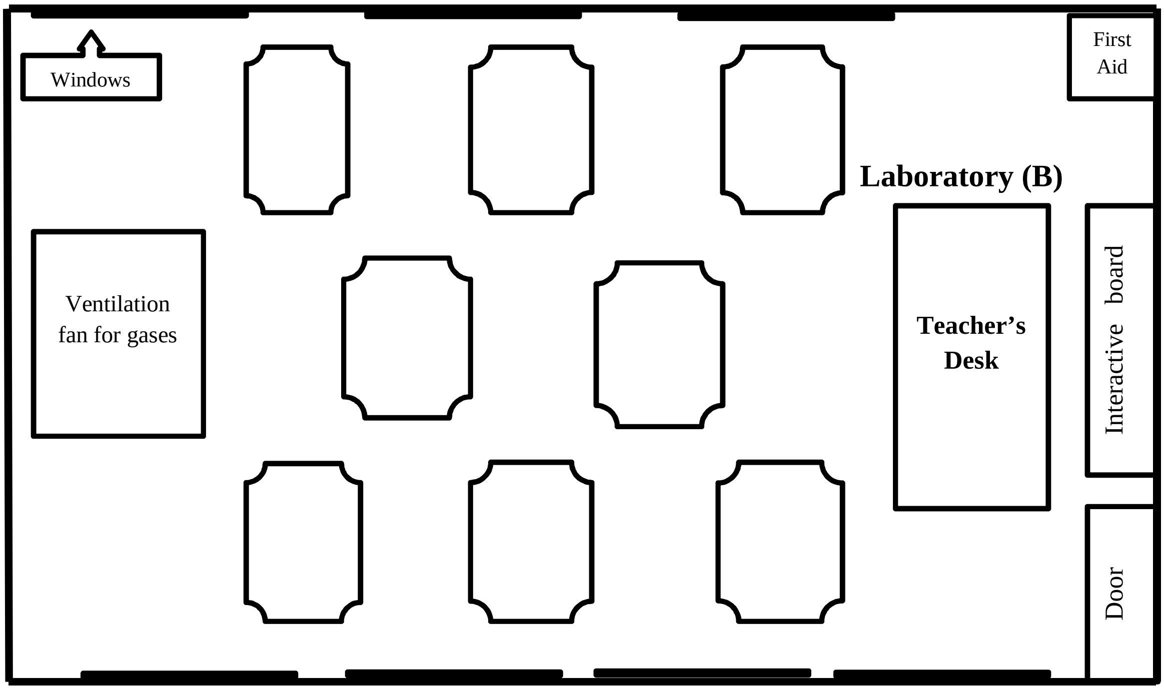


Figure 19: Physical layout of laboratory B in Mohammed's school

My observations revealed that Mohammed extensively used the interactive board, although the physical layout of the laboratory allows the students to conduct practical and group activities. Mohammed agreed that doing practical and cooperative activities could foster students' creativity; however, he argued that such activities need materials and tools, which are lacking. Fostering creativity is conditioned on the availability of high-tech and advanced equipment that requires more financial support for the science department.

> I'd say that the problem lies in the financial allowances received by the Department of Science which is not enough to establish a creative generation. Creativity needs to have many laboratory tools, various and modern educational equipment, fieldtrips, and other things. Unfortunately, we lack those activities due to the lack of financial resources in our schools. (M, Int. 2)

- **School and science mentoring context**

As the head of the science department, Mohammed is very close to school management and science mentors. He has to coordinate the department's tasks, check the teachers' progress, meet with mentors, and participate in preparing monthly and final exams as well as teach science. Mohammed holds negative feelings about asking him and his colleagues to do administrative tasks; he complained about being overloaded and stressed and added that "science teachers are always overloaded with many tasks. Besides, they have to cover all syllabuses; otherwise, they receive penalties. In many cases, I'm asked to do many administrative tasks in addition to teaching" (M, Int. 2). He thought that science teachers "should dedicate their efforts to producing high-quality teaching and learning". He added that "the school management should listen to the teacher's needs, suggestions, and ideas instead of giving orders and setting rules" (M, Int. 2).

- **Societal context**

According to Mohammed, the societal context negatively affects fostering students' creativity and enhancing the quality of teaching and learning in general. People's awareness of the educated person is limited by what sort of certificates he/she has and what grades he/she gets on exams. Therefore, Mohammed talked about himself as a parent and declared that he still guides his children to earn high scores on their certificates and encourages them to do well on exams as a paramount goal of their educational journey. He felt that people's attitude toward education is narrow, and they should be enlightened about the purposes of education and the importance of fostering various skills and abilities, including children's creativity.

8.4.2 Complementary role of the teacher and students

In terms of the students' role, Mohammed pointed out that students must be curious and enthusiastic to discover and learn new things. The students have to show commitment and determination to independently and cooperatively explore different scientific topics. These roles distinguish between creative students with traditional students. "It also depends on the personality of the student. A creative student is a student who would enjoy discovering mystery and who loves to experiment. A traditional student is a student who receives the information for the sake of just receiving it" (M, Int. 2). Nevertheless, Mohammed claimed that the majority are seen as traditional students and concluded that "they do not work hard to improve their abilities"; rather they are studying the subject to "pass the exam, get the certificate, and transfer to a higher grade" (M, Int. 2). Mohammed added:

> It is unfortunate that this attitude is embedded in the culture of our society. Parents want their child to pass exams and succeed. … The goals are passing the exam, obtaining the certificate, and then finding a job opportunity to cover life's expenses. Regrettably, we do not learn simply for gaining knowledge; we learn for certification to pass and become employees. (M, Int. 2)

Meanwhile, the teacher's role according to Mohammed is to create diverse learning opportunities and prepare open learning spaces and outdoor activities. He stated that the teacher should build a "good relationship with his students" and accommodate a "friendly classroom environment" (M, Int. 1). The students in the focus group expressed a similar role of the teacher. They spoke about being a friendly and tolerant teacher who encourages them to share and interact in a secure environment.

> **St. Fadi:** The teacher can make us like science or hate it…. Sometimes, the teacher enters the class, and he is in a bad mood. Then, he quickly gets angry about anything that the students do or say.
>
> **St. Faleh:** Yes, he should be good with us. I mean … the relationship between the teacher and students should be good. (M, St.FG)

The student Fadi indicated this point again in his drawing and commented that the teacher should smile and be in a good mood.

Figure 20: Student's drawing (M, FG, St.Fadi)

Mohammed indicated that another role is connecting the scientific topic with students' lives. He argued that this aspect not only fosters students' creativity, but also adds enjoyment and attraction.

> The students will interact with local issues in a creative way. I remember when I was in college; we went on a trip to the desert, where we were going to learn about the science of rocks. We collected samples from rocks and soil. It was fun for us. Wouldn't it be fun for students in middle school as well? (M, Int. 2)

He argued that science teachers should play a great role in discussing scientific topics as daily issues connected to the students' lives, rather than delivering theoretical information. He believed that such a connection would open more informal learning opportunities for students to participate in and interact with creatively.

8.4.3 Creative learning in the science classroom

Mohammed's believes that learning within a cooperative and friendly environment, where the students' role is central, would lead to a creative learning atmosphere. He supported interactive learning activities that provide space for discussion and cooperation. Mohammed believed that dialogues not only foster creative outcomes within the science lesson, but also foster creative personalities. They enable students to share and deliberate their own personal ideas, beliefs, and concerns and then draw conclusions.

> Creativity is not limited to science; it involves one's personality. When the student discusses and makes conclusions, this helps develop his personality. I enable the students to talk and discuss, not only be listeners. This in itself is a goal. I tend to make each lesson a discussion circle between the students and me. For instance, I can divert from the curriculum to discuss a particular issue with the students and to try to find out more about their hidden thoughts and concerns. Here, I am developing creativity among them. (M, Int. 1)

He believed that most of students' learning should be received through student-centred activities; they have to be "creative with the information that they learnt". Meanwhile, "teachers must act as supervisors or observers rather than a dictator of information" (M, Int. 1). Mohammed indicated that "[he] would like the students to be creative, where they can discover things and draw conclusions on their own" (M, Int. 1). He argued for more open learning by enabling the students to learn from "different resources", such as "learning through scientific trips and outdoor activities" (M, Int. 1).

Nevertheless, he acknowledged the difficulties of transferring these beliefs into reality because of controllable and uncontrollable constraints. As he stated, there are "deficiencies related to the teacher himself" such as the teacher's knowledge, attitudes, and training. Such constraints can be limited by the teacher himself. Meanwhile, the uncontrollable constraints "outweigh the teacher's capacities", such as the syllabus plan, availability of tools and resources, lack of time, and so on (M, Int. 2).

Moreover, he criticized the teacher-centred practices; when the teacher tries to control everything by conducting the activities himself, there is no kind of fostering creative abilities, which leads to the traditional system. "If I set up classroom rules, control the class, control the process, and I leave students for observation only, then this would mean that I am following the traditional system" (M, Int. 2). Additionally, he stated that it is sad to see most of the teachers aim to destructively control the classroom environment. He pointed out that:

> This means that more than 90% of our teaching and learning practices in schools depend on dictation, and the teacher is the only one who can control the classroom environment, where this is very negative. Unfortunately, students in our schools are not allowed to use tools, and only the teacher can control things. (M, Int. 2)

Mohammed was aware that he applies the traditional learning style in his classroom. He blamed the effective influences of contextual factors. In his drawing, for example, Mohammed compared believing in student-centred learning to fostering creativity and his classroom practices. According to Mohammed's drawing, opportunities for students to conduct practical activities, use modern technology, conduct inquiries, engage with outdoor activities, go on scientific trips, and participate in cooperative works are limited applications in reality. Meanwhile, traditional (teacher-centred) learning that relies on the direct transmission of knowledge is widely applied. This claim was clearly evident in his observed lessons.

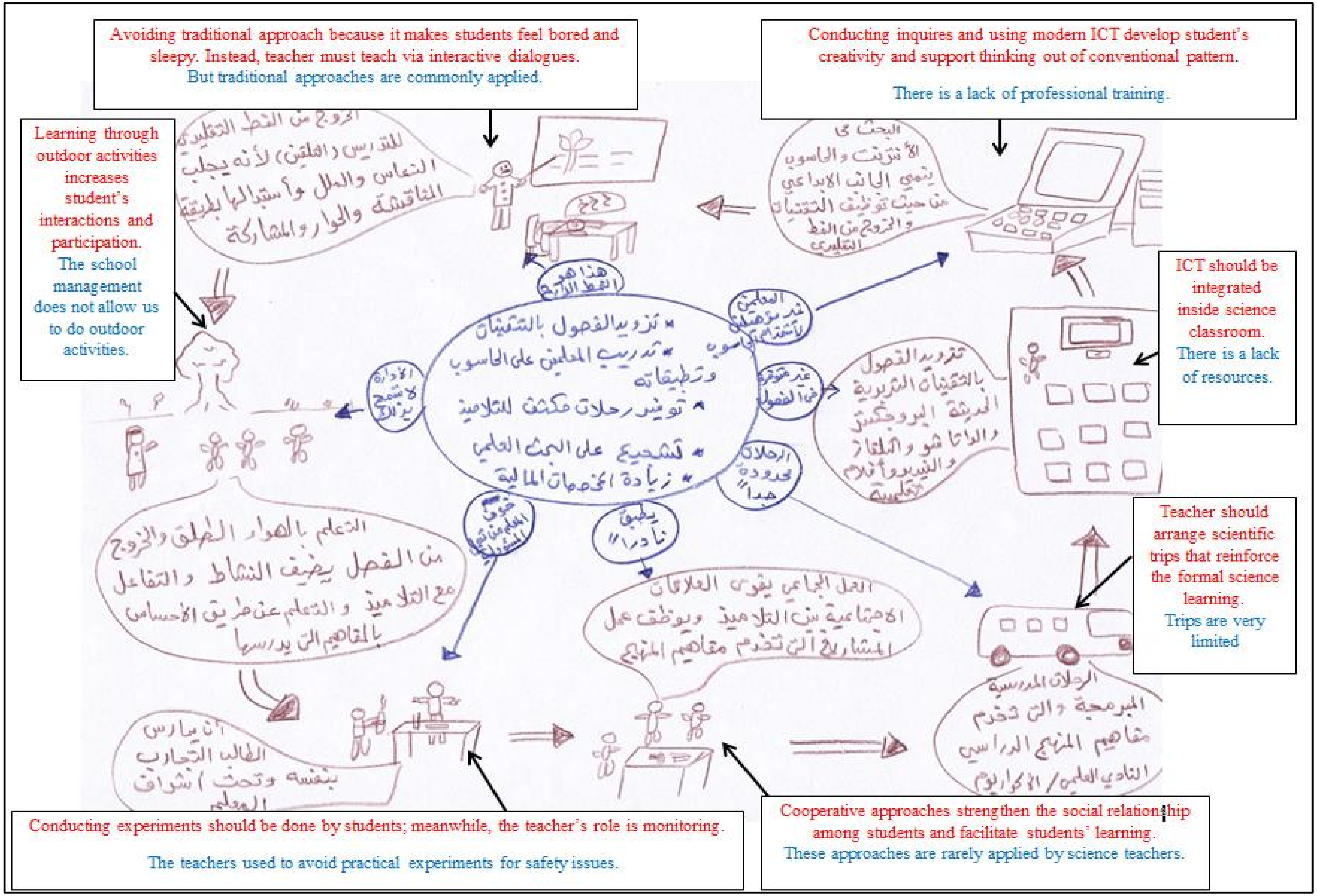

Avoiding traditional approach because it makes students feel bored and sleepy. Instead, teacher must teach via interactive dialogues.
But traditional approaches are commonly applied.
Conducting inquires and using modern ICT develop student's creativity and support thinking out of conventional pattern.
There is a lack of professional training.
Learning through outdoor activities increases student's interactions and participation.
The school management does not allow us to do outdoor activities.
ICT should be integrated inside science classroom.
There is a lack of resources.
Teacher should arrange scientific trips that reinforce the formal science learning.
Trips are very limited
Conducting experiments should be done by students; meanwhile, the teacher's role is monitoring.
The teachers used to avoid practical experiments for safety issues.
Cooperative approaches strengthen the social relationship among students and facilitate students' learning.
These approaches are rarely applied by science teachers.

Figure 21: Drawing by T. Mohammed (M, Int.1)

Consequently, Mohammed held mixed beliefs about creative learning; he believed in student-centred learning and justified the use of teacher-centred learning by reflecting on the contextual influences. He felt sorry and expressed his regret for adopting traditional learning approaches on more than one occasion.

8.4.4 Teaching creativity in the science classroom

In terms of teaching, Mohammed believed that teaching science by adopting new innovative methods leads to creative performances by the students. He connected teaching creatively to teaching creativity, meaning that when the teacher becomes untraditional; his students will generate creative interactions. “I can say that creativity is being outside of the box, outside of the traditional frame, whether in teaching or in learning. In teaching for instance, creativity can occur by creating new methods that help develop the students’ abilities and help unravel concealed skills” (M, Int. 1).

Furthermore, teaching creativity, according to Mohammed’s beliefs, is any approach that enables students to freely interact during the activity and to participate in constructing the activity. For instance, he clarified that students should investigate and search for data and discuss what they find on their own. Such practices stimulate students to be creative. He cautioned that, in order to empower a student to be creative in science class, “you have to come out of the traditional system of teaching, which is the dictation of facts. You have to use a system that is based on allowing the student to discover the facts on his own, to search, to discuss, and to be a student and a teacher at the same time” (M, Int. 1). Thus, he argued that the teaching approaches should support students’ independence to participate in constructing knowledge. He found that trial and error experiments and inquiries are effective teaching approaches for fostering creativity.

Despite the fact that Mohammed disregarded the dictation teaching approach because it makes the students dependent, the observations revealed that Mohammed is a lecturer who did most of his teaching using presentations. In every observed lesson, he extensively used the interactive board to present the lesson’s information; even the experiments were digitally presented to the students. He allowed the students to use the interactive board; it was a common way for the students to interact with Mohammed during activities and questions. In the second interview, Mohammed responded to my observations and stated that "the majority of science teachers give lectures". He added that it is justifiable for science teachers to apply indoctrination and dictation as teaching practices, and he does "not blame the teacher in this aspect, because the teacher is restricted to an obligatory program". According to Mohammed, the textbooks contain a "large quantity of information that should be taught" during a specific period of time, and the science teacher is compelled to conclude all topics and information in the textbooks. "Otherwise he is exposed to legal liabilities" (M, Int. 2).

8.4.5 Reflection on Mohammed's case

The case of Mohammed showed the strength of sociocultural factors on both his beliefs and his practical decisions. Mohammed's beliefs were mixed. He appreciated creative learning approaches where students were the centre of the learning process and were enthusiastic investigators and collaborators in both indoor and outdoor activities. At the same time, Mohammed did not reject the traditional learning approach, but he was reluctant to be a traditional non-creativity-fostering teacher in terms of his practices.

Mohammed blamed the contextual factors, such as societal attitudes and demands, educational policies and instructions, and professional aims and goals. Even when I asked him to draw his vision of how to foster creativity, Mohammed was keen to address the contextual constraints all around the drawing. He blamed the cultural and social influences which direct the teachers to become more traditional teachers who consider delivering textbook information and preparing students to pass exams as their priorities. On the other hand, Mohammed acknowledged that he himself as a parent has the tendency to guide his own children to focus on textbooks and provide the best answers on exams regardless of developing other potentials, including their creative ability. He believed that such an attitude is inherent within the Kuwaiti culture.

8.5 Omar (Consistent, mixed case)

8.5.1 Contexts

- **Personal context**

Omar is a parent of three children: two girls and one boy. He is around 55 years old; he is energetic, elegant, and concerned with his physical appearance. Omar is interested in reading scientific topics and updating his knowledge in the scientific field, especially the field of geology. During the fieldwork, Omar was somehow worried about his boy's performance in school because he is in the final year of high schooling. He wished that his son get over 88% to join medical college and become a doctor. Therefore, Omar told me that he is spending a lot of time teaching and reviewing different subjects with his son to get their targets.

- **Professional–academic context**

In terms of academic background, Omar did not graduate from a school of education; rather, he earned "a bachelor's degree in science from the geology department; [he] … got distinction with honours in the bachelor's degree" (O, Int. 1). Omar was also working on a higher degree in the science of rocks. "I was doing my master's degree in sedimentary rocks. I finished all the modules and wrote the thesis, but I did not do the oral test. I suspended my studies for a while because of my job" (O, Int. 1).

Moreover, Omar is a senior teacher and has been working in the educational field for a long time. He has "26 years of experience as a science teacher" (O, Int. 1). He stated that he has taught science in three countries: 2 years in Egypt, 2 years in Sudan, and the last 22 years in Kuwait. "In terms of my teaching experience in Kuwait, I have worked as a teacher in Kuwait since the Iraqi invasion in 1991. … And I have taught in many schools since then" (O, Int. 1). Omar told me that he has taught four different science curriculums during the last 22 years. He was the oldest teacher in the science department in terms of age and professional experience.

- **Classroom context**

Omar has to teach 16 regular sessions for four classes per week, 4 sessions in each class. He teaches two classes of sixth grade and two classes of ninth grade. There are also 4 standby sessions per week that could be assigned for him when the school administration has irregular situations.

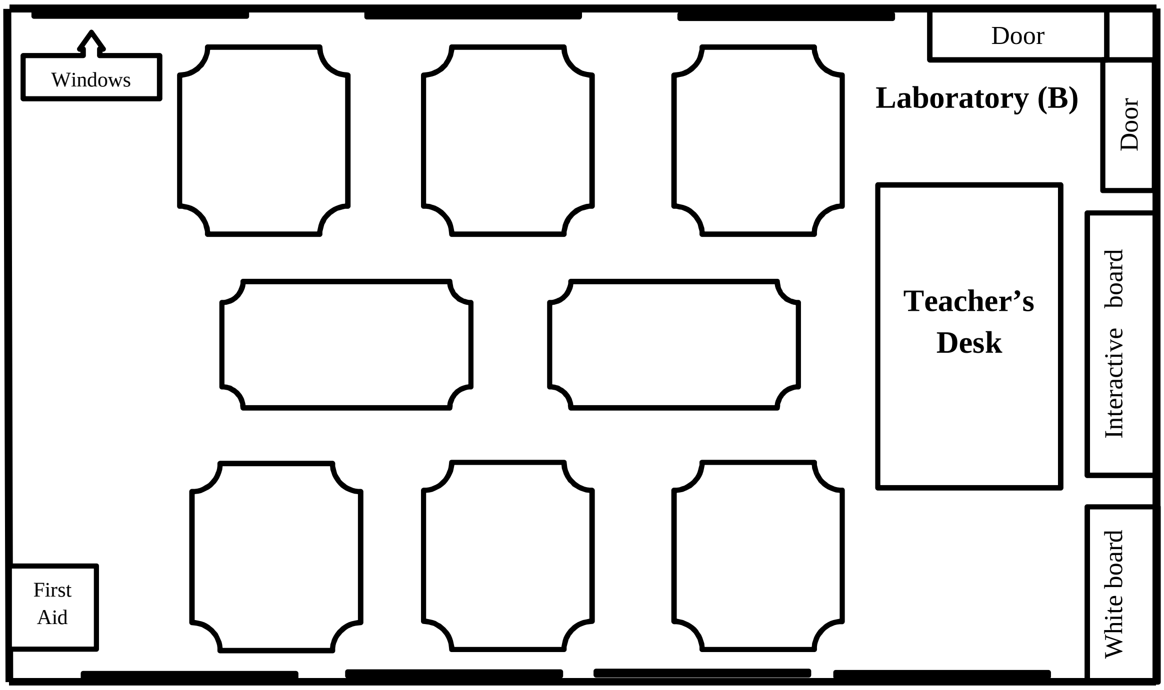


Figure 22: physical layout of laboratory B in Omar's school

I have focused on one of his classes, sixth "A" with 24 students. Four students participated in the focus group. In terms of the physical layout, Omar tended to teach this class in laboratory B. The students' tables were suitable for working as groups or individuals. An interactive board and white board were available inside the laboratory. Omar connected his laptop to the interactive board to present different materials and used the white board to summarize the main concepts of the lesson's topic.

- **School and science mentorship context**

The school was established in 1993 and currently enrols more than 550 students, who are distributed into 26 classrooms. There are 86 teachers and 13 departments, each of which focus on a specific subject. The school management consists of a principal, two principal assistants, two social workers, a psychologist, and other employees. According to Omar, the school management does not pay attention to creative education and provides poor rewards to the students who creatively perform in any subject. Omar criticized the role of school management:

> The school management does not take care of the quality of teaching and learning. I mean the school management asks us to do administrative tasks without thinking that these extra tasks could reduce the quality of teaching and learning. I am a teacher, not an administrator. (O, Int. 2)

The science mentor focused on the quality of teaching and learning science. Nevertheless, Omar was unconvinced about how to assess the quality of his teaching. He pointed out that "the science mentor looks at students' records; if the rate of success is less than 70%, the teacher is bad or not qualified. Then the mentor will initiate an official investigation to know the reason for the low rate of success" (O, Int. 2). Thus, most teachers aim to "help their students pass exams in order to avoid this official investigation" (O, Int. 2).

- **Societal context**

Omar talked about the role of scientific societies within the Kuwaiti community in encouraging schools to foster creativity in science; he acknowledged that the current role is weak and limited to some occasions. Therefore, he believed that creating a partnership between these experienced societies and science teachers is highly recommended to move toward creativity-welcoming schools. Moreover, he held optimistic feelings regarding the Kuwaiti people's awareness of the significance of creativity and innovation.

> The role of society is very important. When you watch the annual conference of Arabic inventors, you will see that most of them come from [Arabian] Gulf states—around 70% percent of the participants are from the Gulf. But in the past, the number was very few compared to inventors from other Arabic countries. I think our society is more open to the world. (O, Int. 1)

Omar found that people are becoming increasingly interested in raising the quality of education and demand more refinements in the educational system, which creates pressure on the Kuwaiti government and the Kuwait national assembly (Kuwaiti Parliament).

8.5.2 Complementary role of the teacher and students

Omar believed that, in order to foster students' creativity, students must be "independent in their learning" (O, Int. 2). They should "learn from different resources; they might search via the internet, visit the library and read books, or meet and ask other people" (O, Int. 2). Meanwhile, the teacher has to provide them with "diverse opportunities", "enough time", and "free space for interactions" that encourage independent learning (O, Int. 2). The students themselves shared similar beliefs, explaining that creative students should not depend only on school activities for their learning; rather they must be independent and learn on their own and be prepared for school.

> **Majed:** If I want to know something, I search using Google.
>
> **Rabeh:** I mean, a creative student should be prepared at home, reading books and searching via Google.
>
> **Nabeel:** Yes, he should depend on himself and learn at home and do some investigations about interesting topics.
>
> **Rabeh:** The school is completing his learning. … Students should train their minds before going to school…, they should play Sudoku.
>
> **Researcher:** Play Sudoku!
>
> **Majed:** What! … What does Sudoku mean?
>
> **Rabeh:** Sudoku is for warming up your mind… you don't know it! … It has numbers and squares. You need to put the unknown number in the square or in horizontal or vertical rows. It is for stimulating minds. (O, St.FG)

While Omar and I conducted the first interview, he drew a map and stated that there are many approaches to foster students' creativity. "Some teachers could focus on thinking skills, and others could focus on integrating technology…. I like to focus on practical and psychomotor skills to foster creativity in the science classroom" (O, Int. 1).

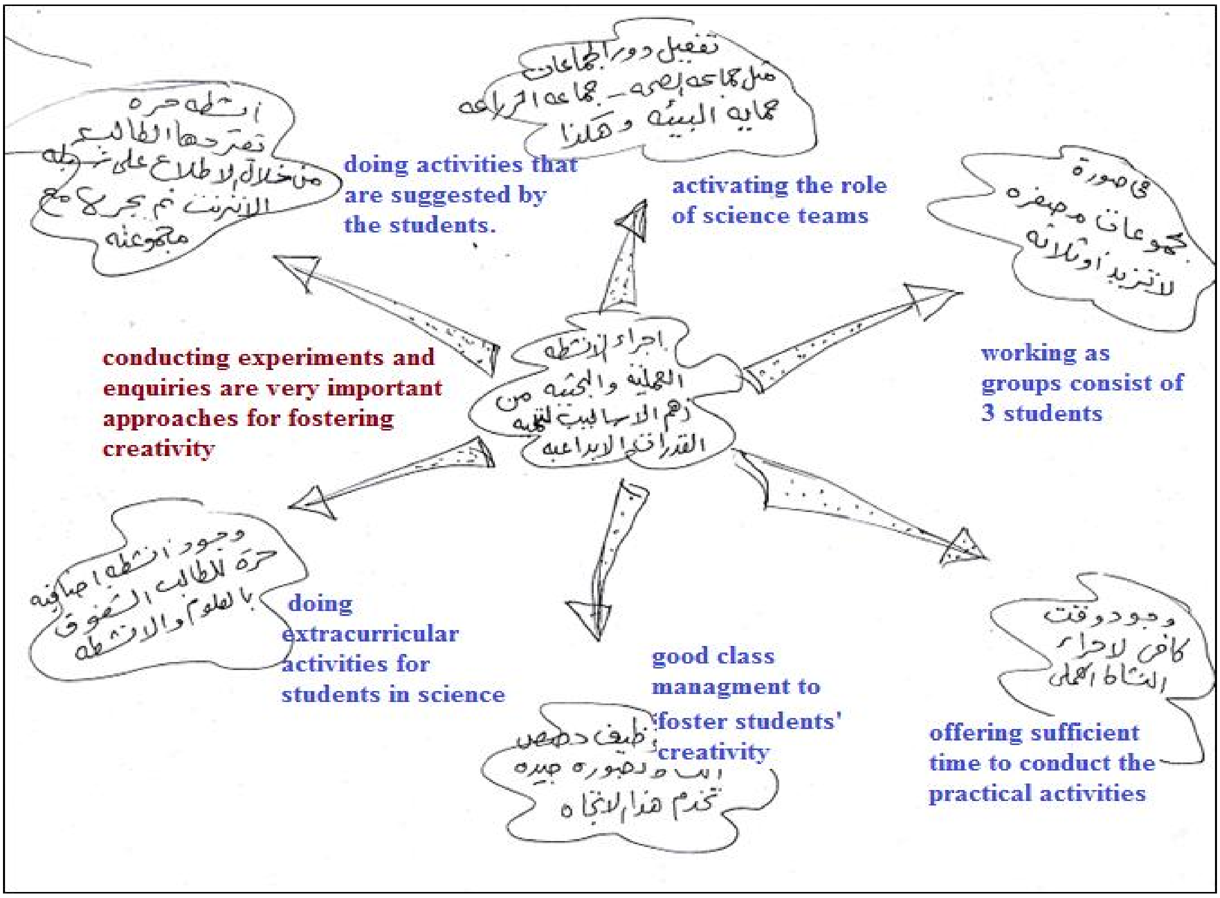


Figure 23: Drawing by T. Omar (O, Int.1)

Omar believed that his role is to put the students in interactive situations; therefore, he found that his role is to create a cooperative and friendly learning environment and build up psychomotor skills by supporting students' experiments and inquiries, as illustrated in his drawing.

8.5.3 Creative learning in the science classroom

In the first interview with Omar, issues related to student learning were addressed. Omar held mixed beliefs about learning. He argued for learning through student-centred approaches, where the students should learn through working cooperatively and independently in order to foster their creativity. Yet he supported teacher-centred learning as well and found it to be an effective learning approach.

> I am against the idea that students are only recipients of information. Rather, I prefer that they participate and conduct experiments. Teachers are supposed to have the tools to allow students to do so in groups. Thus, students can work in groups. Also, teachers have to offer students the freedom to start doing experiments on their own. (O, Int. 1)

Notwithstanding, Omar acknowledged the importance of teacher-centred learning as well. He believed that teacher-centred learning is effective learning in terms of delivering the scientific concepts and information in a short time. Thus, Omar believed that it is illogical to support student-centred learning all the time.

> I have to teach and deliver the scientific concepts of the lesson. I have to make the students recall old information to make connections with new information. I have to assess their understanding and evaluate the lesson aims…. I mean all these things in 45 minutes. It does not make sense to offer enough learning opportunities for the students. (O, Int. 2)

With regard to classroom practices, both student-centred and teacher-centred activities were evident. For example, some activities relied on students' interactions, such as the lesson of "chemical and physical changes" (O, Obs.2) and "chemical analysis of the water" (O, Obs.4). "The students worked as groups, in which each group has a number of objects and should identify the type of change of each object. The teacher was moving around the groups and checking their understanding" (O, Obs.2). The students also conducted chemical experiments to "analyse the water; they were divided into five groups and conducted the experiment according to the workbook instructions". The student Waleed also described cooperative learning in his drawing. He believed that group work activities strengthen social relationships among students and build dialogues within the groups to cooperatively complete the tasks.

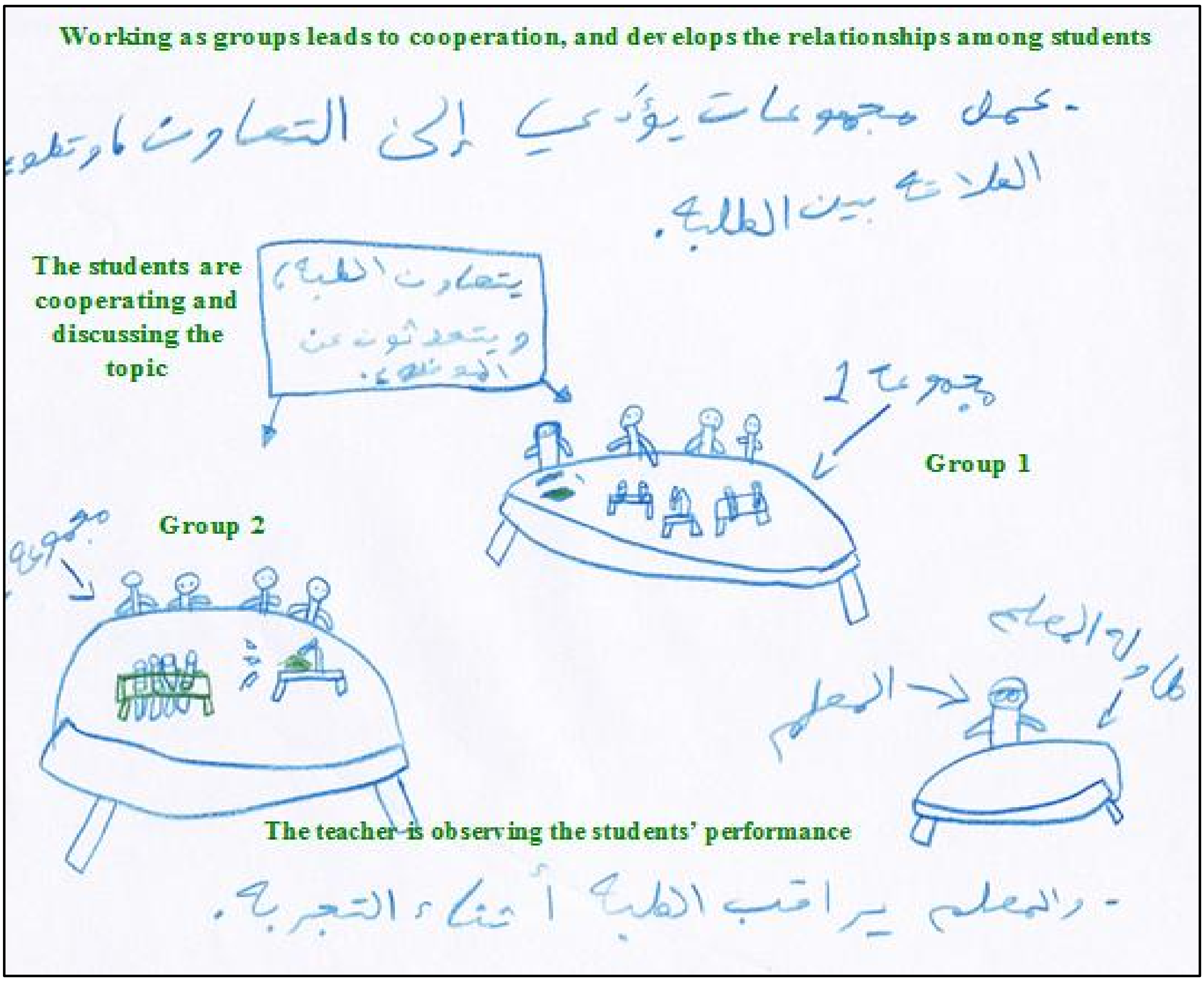


Figure 24: Student's drawing (O, FG, St. Waleed)

My observations also revealed that Omar controls classroom activities. His scientific demonstrations are equal to students' practical activities. Controlling activities by limiting practical activities and the use of ICT strengthen the teacher-centred learning. On different occasions, his students received information with or without limited interactions. During each observed lesson, Omar was able to dictate information and scientific concepts while the students watched the teacher's demonstrations and PowerPoint presentations. One of the students visualized this situation in his drawing. Majed drew his teacher (Omar) holding a stick to point to the white board and explain the scientific video clips. Meanwhile, the students were looking at the white board and listening to the teacher's presentation. This description of displaying video clips and PowerPoint files was evident in all the observed lessons either through the overhead projector or the interactive board.

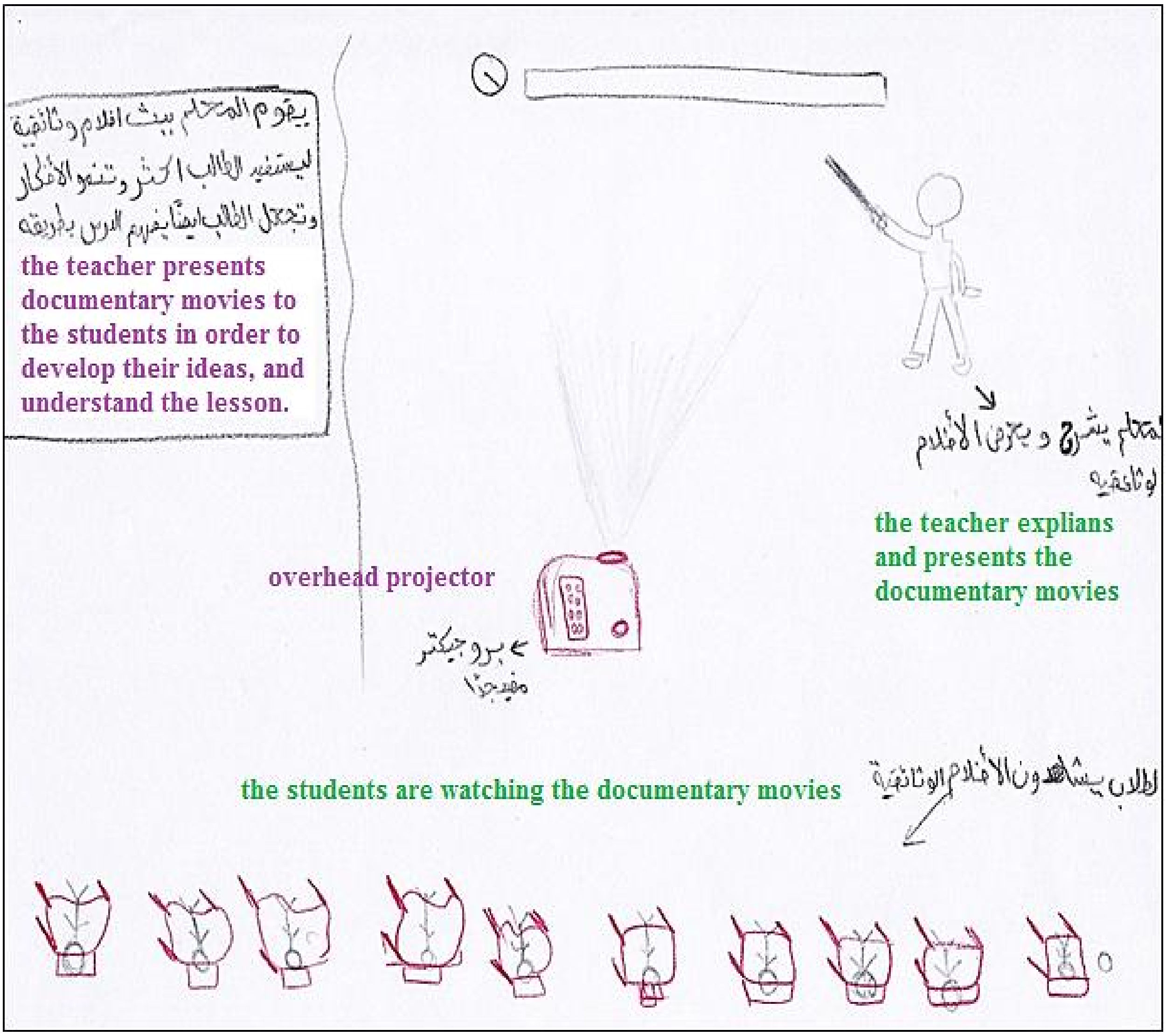


Figure 25: Student's drawing (O, FG, St. Majed)

Majed was not the only student who mentioned the teacher's presentations; his peers also referred to delivering information. For example, two participants of the focus group (Rabeh and Waleed) shared similar notifications when I asked them about the common type of practices in their science classes.

> **Rabeh:** Usually … the teacher repeats the important information. I mean, if there is important information, he usually says this is a very important point.
>
> **Waleed:** And he poses homework questions about this point.

> **Rabeh:** Also, he repeats the information more than once to keep this information in our minds.
>
> **Waleed:** We listen to him for long time and watch the movies to understand the lesson. (O, St.FG)

Omar's justification was needed. Therefore, during the second interview, I asked him about the direct transmission of information. Omar pointed out that "there are major concepts and information that should be understood by the students … to pass the exams. And I want to make sure that my students comprehend these concepts. When I deliver the information myself I can save time and cover the content" (O, Int. 2). He also added that "the textbook has extensive information and many topics, and I have to teach all this information and follow the syllabus plan" (O, Int. 2).

8.5.4 Teaching creativity in the science classroom

Omar held mixed beliefs toward teaching creativity; he also appeared to apply mixed teaching approaches. Omar stated more than once that enabling the students to do practical investigations and inquiries can foster their creativity. However, he strongly defended the direct transmission approach as a fundamental teaching method.

One of his chief teaching approaches is allowing students to do practical activities to build up their psychomotor and investigative skills. He believed that developing these skills are one of the priorities of science and can lead to creative performance. For example, he said "I would like for students to do things with their own hands. I would give them the freedom to touch things, to do things on their own, and to test their ideas" (O, Int. 1). Omar strongly believed in enabling students to be creative and discover new things by creating free opportunities for them to interact and investigate. He argued that being creative in science cannot be achieved without providing free learning opportunities. "One cannot be creative when constrained. For instance, if I ask the student to conduct a specific experiment with specified principles and specific information, this is not creativity, because creativity requires freedom" (O, Int. 1).

Therefore, Omar encouraged his students to work together and cooperate when they conduct practical experiments. He tried to facilitate cooperative and free learning opportunities for his students to shape their autonomy. For example, the experiment of electrical analysis of the water was done through group work. Omar also enabled his students to conduct an experiment on chemical changes in 5 groups, where each group member did one procedure of the experiment. "One is responsible for putting the vinegar in the flask. Another student is responsible for putting $CaCO_3$ in the balloon. Another one is responsible for connecting the balloon to the flash and spilling the $CaCO_3$ in the vinegar" (O, Obs.5). Such practices can lead to "open dialogues and discussions among the students" and the emergence of "personal reflections and thoughts" (O, Int. 2). Furthermore, the students shared similar beliefs about conducting practical experiments; they found this approach enjoyable, inspiring, and engaging. For instance, the student Rabeh drew his peers working as groups to conduct a practical experiment to answer "what if questions". He pointed out that "working as groups facilitates creative thinking".

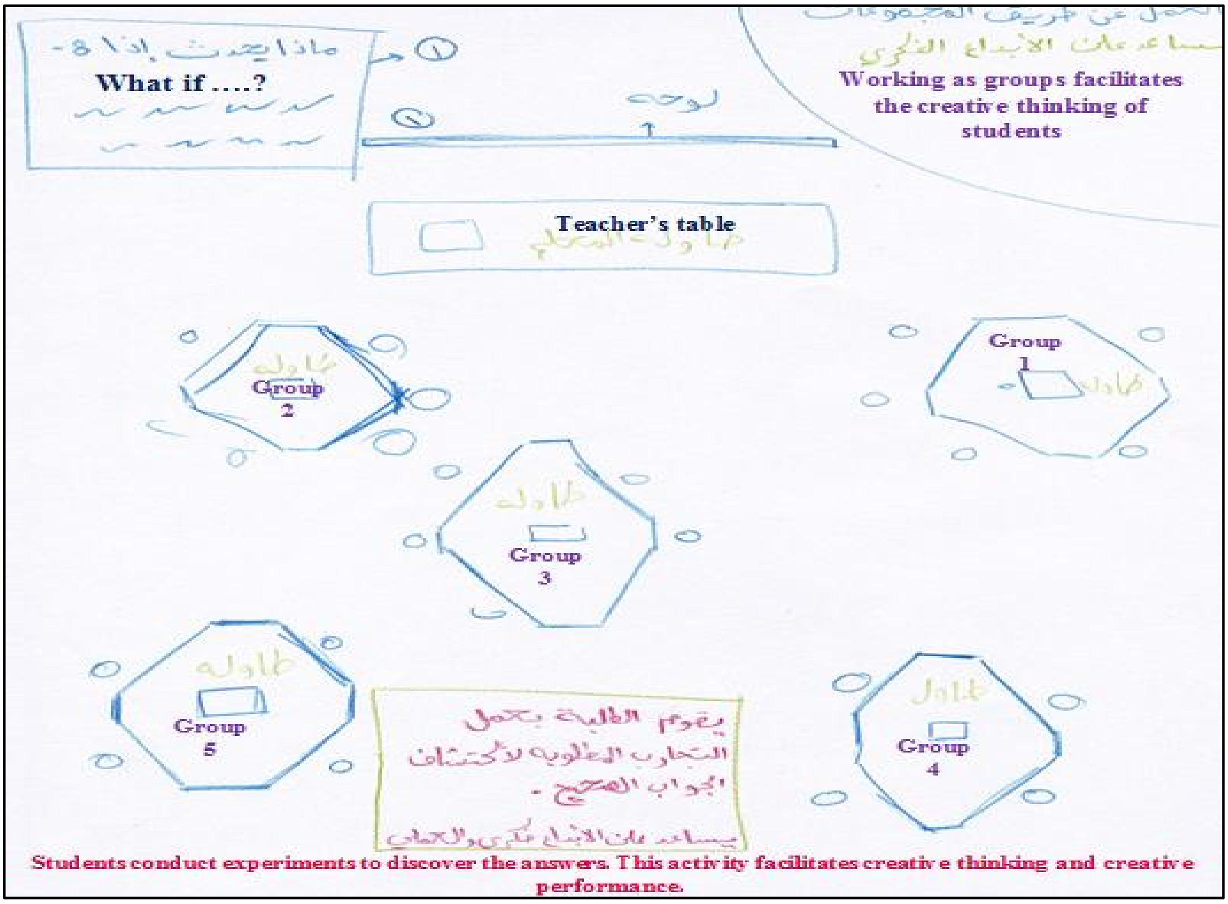


Figure 26: Student's drawing (O, FG, St.Rabeh)

Accordingly, Omar's beliefs and practices with respect to practical and cooperative activities were consistent; however, the observations highlighted a divergence between what he stated about conducting inquiries and what he did inside the classroom.

More specifically, repeated assertions were found regarding the role of the inquiry approach in fostering students' creativity in science subjects. Omar firmly believed that inquiry is "an essential approach for creativity" (O, Int. 2). It enables students to "pose questions and find solutions" (O, Int. 2). In the first interview, for example, Omar recalled an example of his students' inquiry about water consumption, in which one of the students did an impressive investigation to predict the cost of water drops leaking from a tap without Omar's help.

> One of the students noted that a drop of water can cause a lot of loss as he calculated this. He defended this using an example: If you made a hole in a barrel and let the water leak out of it for an hour, you could count the amount of leaking water within an hour and multiply it by 24 hours, then again by 30 days. It was dazzling that he started using digital data in addition to the practical side, which made his research a valuable one. (O, Int. 1)

Nevertheless, Omar acknowledged that inquiry is not a subject for daily classroom practice. Few students can benefit from this approach. He admitted that open inquiry is mainly "applied in extracurricular events limited to students who have an interest in a particular area of focus" (O, Int. 2). Extracurricular activities such as scientific inquiry projects, science fairs, science clubs, and teams are "attractive only for interested students" (O, Int. 2). Thus, he sought to motivate students and reward them according to their creative efforts to increase the number of participants and maintain the students' temptations to come up with creative ideas and behaviours.

8.5.5 Reflection on Omar's case

The case of Omar represented the consistent case, where beliefs and practices are mixed. Both traditional and progressive beliefs as well as practices were evident. In terms of his beliefs, he was very concerned with building up the skills necessary for science, like developing psychomotor skills, to enable his students to do practical investigations inside the lab and try to figure out the conclusion of the learning process by conducting practical investigations or through inquiries. Nevertheless, he found that being a traditional teacher and focusing on textbook information are part of his responsibilities as a teacher and should be done on time according to the fixed syllabus. Therefore, his practices sometimes appeared to be progressive, where the students' interactivity is high within group works and dialogic activities; in other observed classes, the students were totally passive learners.

Furthermore, Omar found that extracurricular activities create a welcoming context that embraces students' creativity and enables them to perform creatively. Such activities are not restricted by fixed orders and external constraints. Therefore, more support for such activities is needed, and students who participate in such activities need to be encouraged by the system.

8.6 Khalid (Inconsistent, mainly progressive case)

8.6.1 Contexts

- **Personal context**

Khalid is single 28-year-old man who likes to learn about and use modern technologies. He is keen to review newly released technological devices, especially communicative and interactive deceives. He is also a photographer interested in taking astronomical photos, which is his favourite hobby. The walls of the science department were full of astronomical pictures taken by him and another like-minded science teacher who is his best friend. Khalid and his best friend go to the desert to photograph the moon and other planets and stars. During breaks, Khalid shared with me some of his albums and told me the stories of some of the photos. He is a talkative, extroverted, and sociable person. Khalid complained about the overloaded tasks and believed that such overload negatively affects his "personal life" (e.g., requiring him to prepare and plan for lessons at home). He said that "I'm not supposed to do any work after work hours" (K, Int. 2).

- **Professional–academic context**

Khalid does not have a degree in education; he has studied chemistry for bachelor degree and has graduate degree as well. He identified himself and said “I have a bachelor’s of science with a major in Chemistry. I also have a graduate degree in biochemistry” (K, Int.1). Khalid assumed to be laboratory technologist after his graduation; he was not expecting to be working in the educational field. However, he became a teacher instead of a laboratory technologist when he applied to the Ministry of Education to work as a secondary school teacher. Yet the Ministry of Education did not assign him to teach in secondary schools, like he wanted. He was hired to teach science at an intermediate school. He justified this by saying that “this happened because of the new curriculums, which required more classes. As a result, more secondary school teachers were needed, and I was hired here at the intermediate [school]” (K, Int. 1).

I asked him about his training in terms of teaching and education in general. He did not enrol in any pre-service courses; he depended on his own efforts to meet the requirements of the Ministry of Education.

> I read about education and teaching because I was aware that the Ministry would not hire a teacher unless he met the minimum requirements of teaching techniques. At first, I found some books and some articles on education, and I studied them. These books and articles were about teaching approaches, such as how to deal with students, problem solving, illustration methods, and learning styles. I have also looked into the best methods of how to prepare for class. I studied and read all these topics before going to the interview at the Ministry. (K, Int. 1)

In terms of professional experience, Khalid has been “teaching science for four years”; he developed his teaching approaches and preparation techniques during in-service training courses and workshops provided by the Ministry of Education. During these four years, he has taught students from all intermediate grades (sixth through ninth).

- **Classroom context**

Khalid prefers to teach his students in laboratory A rather than teaching them in their original class because the laboratory contains materials and tools for practical activities. He can also use the smart board and the overhead projectors to display different materials.

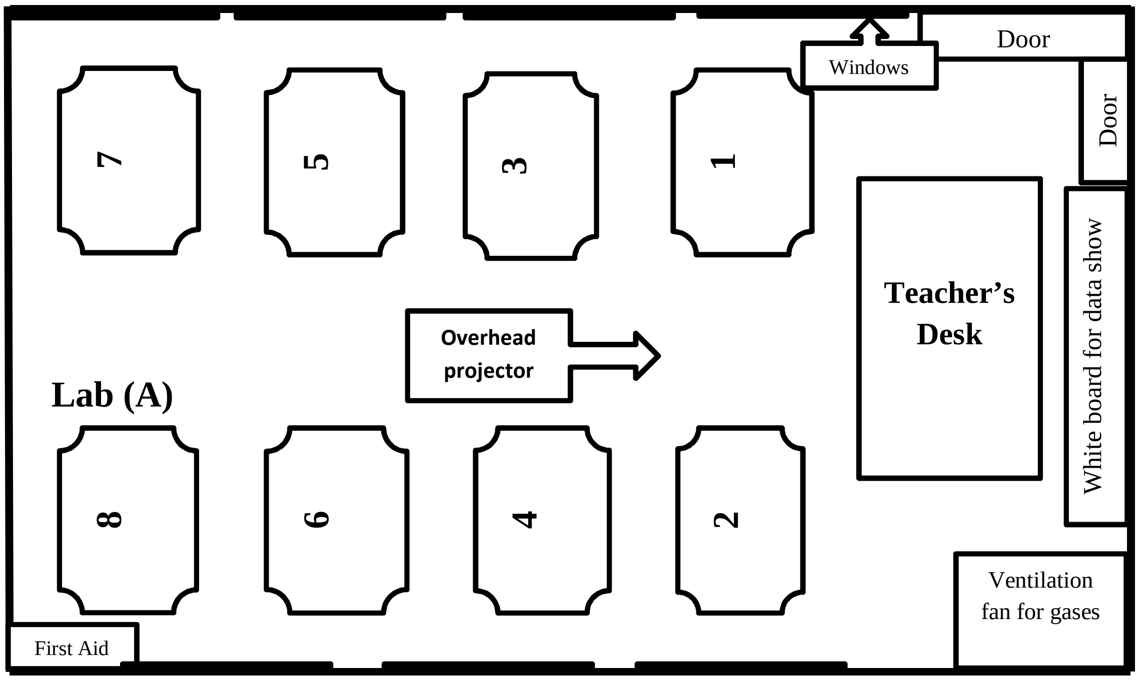


Figure 27: Physical layout of laboratory A in Khalid's school

There are eight tables; each table can be used by four students. The laboratory structure allows students to work individually or cooperatively in groups. For the duration of the fieldwork, Khalid taught "students from four classes … two ninth-grade classes and two seventh-grade classes" (K, Int. 1). I focused on one of his ninth-grade classes, which had 24 students. Khalid stated that there is a lack of some tools and materials that prevent him from conducting practices for fostering students' creativity.

- **School and science mentorship context**

Khalid has four classes, each of which includes four science sessions per week. He has to teach 16 regular sessions per week and four standby sessions that can be assigned by the school administration when there is lack of staff numbers or absent colleagues. He not only has teaching tasks, but also different assignments arranged with school administration as well as assignments arranged by his science mentor. The school management usually asks Khalid to do extra tasks which are considered to be "extra routine" by Khalid. He felt that such tasks make him overloaded and stressed (K, Int. 2). Frankly, Khalid considered any task that is part of teaching his classes to be extra routine; he strongly believed that science teachers should be dedicated to teaching their students without asking them to do anything else.

The central interest of the school management is to prepare students to pass school examinations while staying in line with the Ministry's syllabus. Teaching and learning are affected by such interest. Khalid is required to meet the school's interests by focusing on helping students pass monthly and final exams. Thus, Khalid listed more constraints to fostering students' creativity in his class because of the fixed instructions and roles of the school and science mentor. He complained about the "lack of time", "restricted syllabus plan", and "rich textbook content" (K, Int. 2). For example, Khalid stated in the second interview that he "can become irritated by students' questions because the lesson comprises a lot of information and should be delivered in a short time" (K, Int. 2).

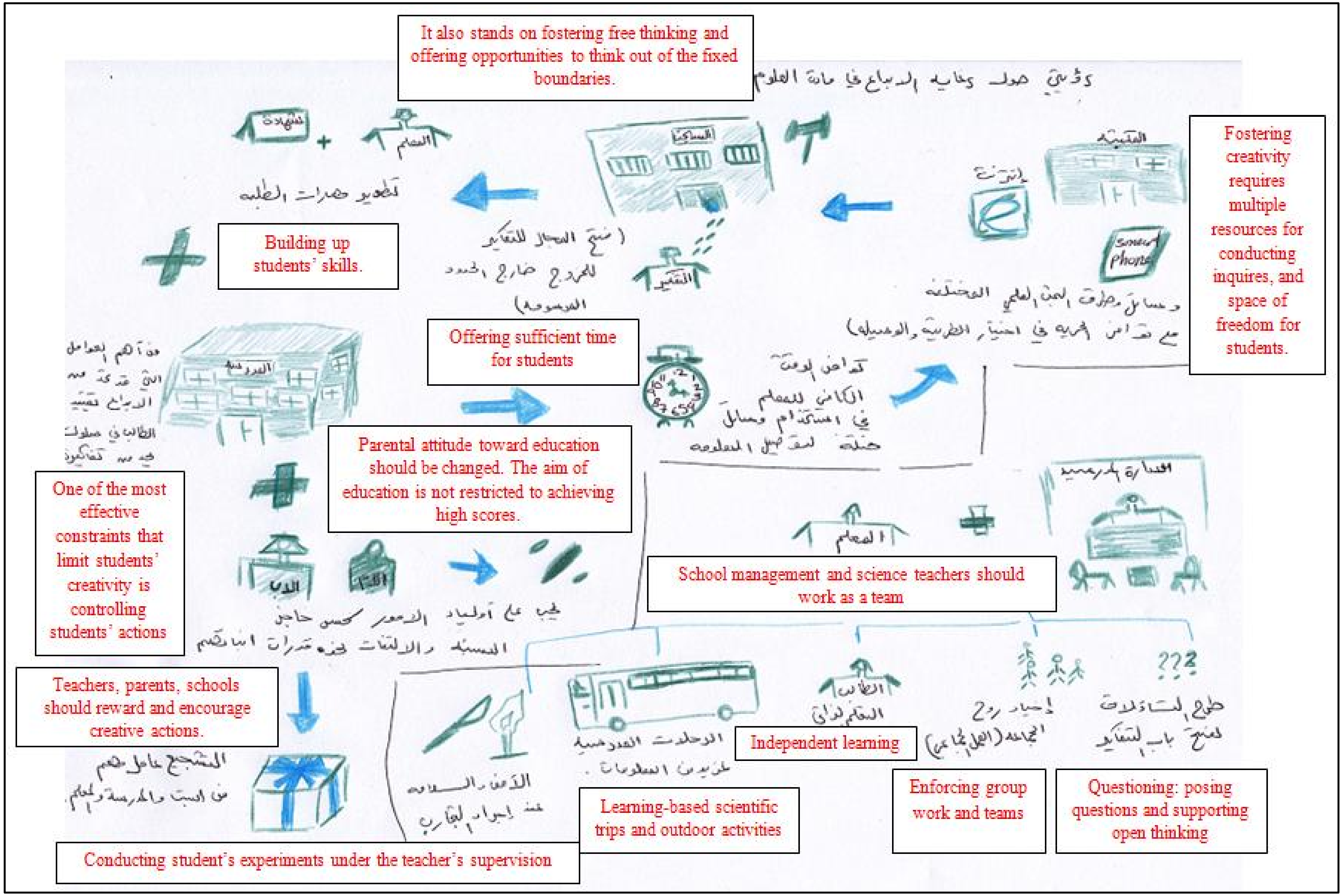
- **Societal context**

Khalid did not speak much about the societal context in terms of its influences on his beliefs and practices as a science teacher. However, he reflected on people's perspective toward the purpose of education. He disregarded the idea of attending school and completing studies for the sake of getting a job. He acknowledged that it is an indispensable aim, but the purpose of education is not restricted to getting a job. By contrast, there are a group of aims that should be considered by people, such as developing skills, gaining morals and principals, and increasing individuals' productivity and performance.

8.6.2 Complementary role of the teacher and students

The role of the science teacher is to spark students' interest in learning science and keep them motivated and curious about understanding scientific phenomena. Khalid also believed that helping students think about the received information would increase the potential for manifesting creative ideas because he saw creativity as a form of thinking. He also indicated that encouraging students to question things is more likely to lead to non-traditional answers.

Obviously, Khalid addressed a lot of roles by referring to different agents, such as himself as a teacher, students, parents, and the school principal. For example, Khalid painted a complex drawing during the first interview; he pointed out multiple aspects, concerns, and roles creating complex relationships (Figure 28).



It also stands on fostering free thinking and offering opportunities to think out of the fixed boundaries.
Fostering creativity requires multiple resources for conducting inquires, and space of freedom for students.
Building up students' skills.
Offering sufficient time for students
Parental attitude toward education should be changed. The aim of education is not restricted to achieving high scores.
One of the most effective constraints that limit students' creativity is controlling students' actions
School management and science teachers should work as a team
Teachers, parents, schools should reward and encourage creative actions.
Independent learning
Enforcing group work and teams
Questioning: posing questions and supporting open thinking
Learning-based scientific trips and outdoor activities
Conducting student's experiments under the teacher's supervision
Smart Phone

Figure 28: Drawing by T.Khalid (K, Int.1)

Khalid's drawing highlighted multiple approaches to fostering creativity, such as fostering thinking skills, cooperative works, practical experiments, and self-learning. He also addressed some facilitating factors to apply these pedagogical approaches, such as having enough time, external rewards and motivation, and open opportunities for students' thinking and participation. However, he believed that his role is influenced by the roles of others; in which the sociocultural elements play great roles in putting his beliefs into practice. In his drawing, for example, he also referred to parents, school management, and the educational systems. As he said, it "depends on many factors. For instance, the environment where the student lives, the teaching techniques of the teacher, the behaviour of the students in the classroom …, and the available resources that are used by the teacher" (K, Int. 1). Therefore, he believed that not only the teacher and his students need to take part and play specific roles, but other agents should also be involved and be facilitators to ensure a proper learning context that welcomes students' creativity.

8.6.3 Creative learning in the science classroom

In the first interview, it was evident that Khalid held progressive beliefs about creativity fostering. Khalid believed that science should not be delivered by recitation and dictation. "The most important thing in the science classroom is not to follow the system of reciting information and giving speeches" (K, Int. 1). Fostering creativity needs student-centred learning in which students play a great role in the class. Therefore, Khalid referred more than once to the significance of students' participation in activities, and avoiding direct transmission through giving lectures and speeches from one direction. When I asked him to tell me about the pedagogical aspects for fostering creativity, he said:

> The most important thing in the science subject is not to use speeches as methods of communication—I mean, sit down and just keep talking and talking. However, you have to let the students take part and participate. It is true that their answers may not be logical most of the time, but I have no problem with that. (K, Int. 1)

Khalid aimed to incorporate his beliefs about cooperative learning into his classroom practices. For example, he prepared a cooperative activity in which a large number of students participate and interact in the lesson on the Rutherford model. The students did an acting scene where students used laser pointers to act as the electrons around the nucleus. Meanwhile, a student stood in the middle, representing the nucleus.

> One student is standing on the middle of the laboratory representing the core of the atom. Meanwhile, 10 students are standing on one side of the laboratory, holding laser pointers to represent the electrons. They switched the pointers on and pointed them in front of the student in the middle. The teacher asked the whole class to use their imaginations and explain what they found (K, Obs.2).

In the focus group, the students spoke about cooperative learning as stimulating and inspiring practices. They also referred to the second observed lesson about the atom structure, when asked to offer an actual example of cooperative practices.

> **Rashed:** It is about the chemistry of atoms … about the revolutions of the Rutherford and Bhor theories of an atom’s structure.
>
> **Salman:** All of us … we participated in the practical activity.
>
> **Rashed:** How the rays pass–
>
> **Salman:** –we learned about gold plates. How the rays pass it.
>
> **Rashed:** Yes, some rays can pass and others incline.
>
> **Salman:** All of us participated in this activity. We held the laser pointers and pointed in the middle of the laboratory. When the rays come across the body, some of the rays incline and others encounter and return back. But they are few. We did it and enjoyed the lesson. (K, St.FG)

Two students drew this particular activity, in which they and their peers are doing the Rutherford experiment. Salman, for example, wrote on his drawing “I liked this activity because it contains cooperative and practical work, which encourages the student to learn through experimentation”.

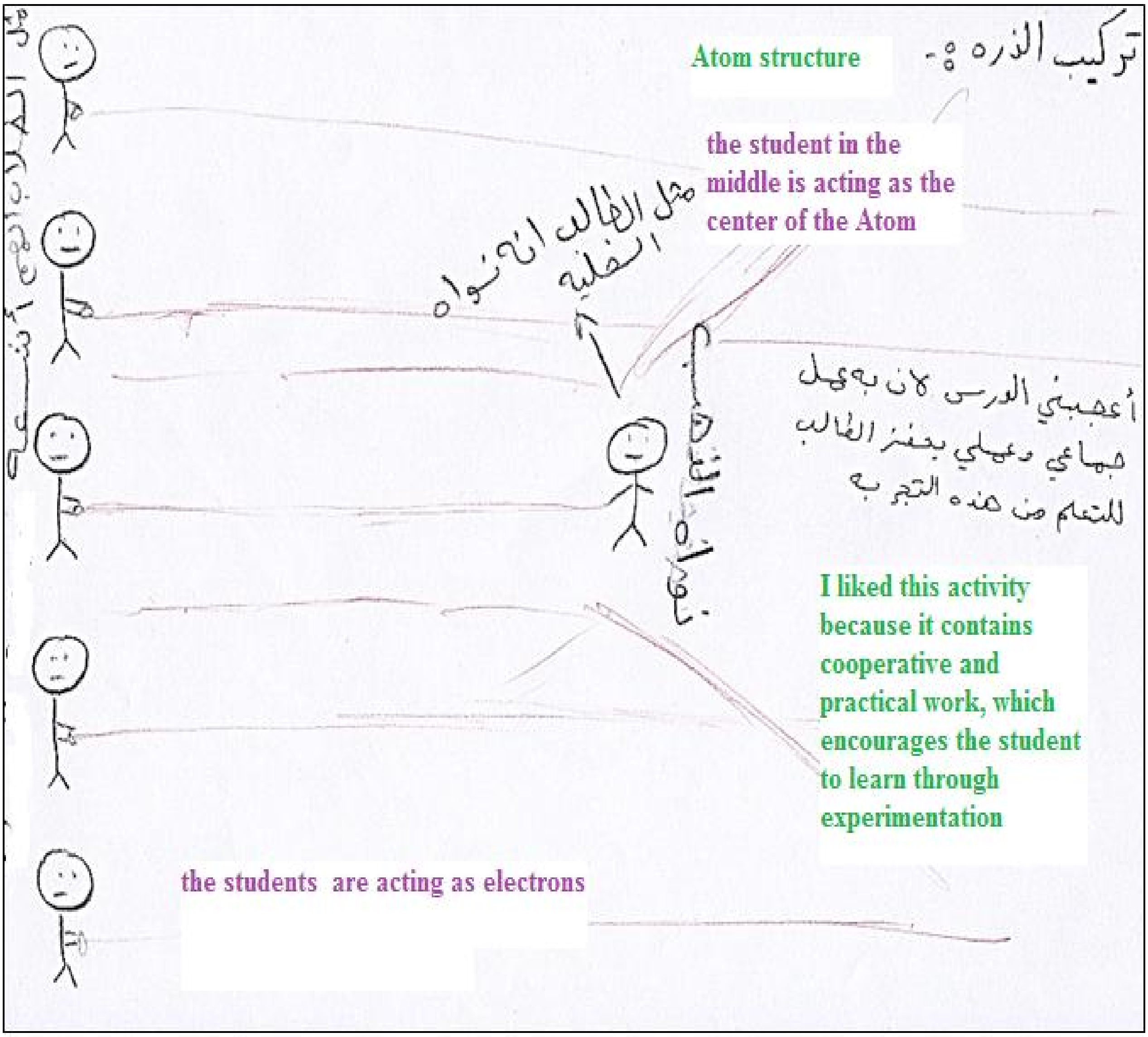


Figure 29: Student's drawing (K, FG, St. Salman)

In the second interview, Khalid made strong statements about avoiding methods that do not encourage students' participation, such as lecturing. Khalid strongly stated that "nobody can deny the fact that learning must be student-centred" (K, Int. 2).

However, the observed lessons also showed that Khalid tends to control the group works. He justified this pedagogical behaviour when he said that "participation has some disadvantages. Sometimes when there is too much participation, noise and disorder increase in the class. … In this case, you would have to control the class, because if the class remains like this, then no one in the class will understand anything" (K, Int. 1). He not only indicated that participation could lead to disorder, but also believed that controlling it is his priority; other pedagogical aspects come after that. "Order in the classroom comes first before everything else. This means that when there is disorder in the class, even the student who will answer correctly will not be rewarded as a punishment for his contribution to the disorder by answering without the permission" (K, Int. 2).

Sometimes Khalid's practices were not far from lecturing and presenting information. Teacher-centred activities were observed in Khalid's class as well. For example, the third observed lesson was a teacher-centred session; the students did not do anything. He was explaining and delivering information without even a short break for students' questions. "Khalid was giving a lecture about meaning of the main levels and under levels as a part of the electronic movements in the atom. He took around 15 minutes to explain these points for the students. There was no interaction from the students, only watching the PowerPoint slides" (K, Obs.3).

During the second interview, I pointed out my observations regarding the use of direct transmission and the lack of students' activity. Khalid justified his approach by referring to three constraints: insufficient time, the richness of the textbook content, and the restricted syllabus plan. Khalid criticized the current length of time and was unsure that the current time helps him foster students' creativity while meeting the curriculum plans. "For the sake of fostering my students' creativity in science, I would have to spend more time with them. Do not convince me that I can complete the lesson and foster their creativity in this short period of time" (K, Int. 2).

8.6.4 Teaching creativity in the science classroom

Khalid held that creativity and thinking skills are extremely correlated and overlapping. He believed that creativity is a way of thinking: "Creativity… in my opinion, it is the ability to think. If the student is able to think, then he will be able to be creative. The most important thing is to make the student think" (K, Int. 1). He viewed creativity as a thinking process in which creativity cannot emerge without knowing how to think: "This is because creativity is a form of thinking" (K, Int. 1). This sort of connection seems to be the fundamental basis of his pedagogical beliefs about how to foster students' creativity in his class.

More specifically, Khalid believed that questioning and reasoning are key thinking skills that lead his students to show a creative performance. He stated that fostering questioning and reasoning skills inside the class forms unexpected questions and thoughts beyond the students' age. In this case, the students will pose "questions that ask about something that I myself learned in detail only during my university education or my diploma education" (K, Int. 1). For example, he explained his beliefs using two real examples that happened during his teaching experience.

> A student asked me, "you are saying that chemicals are used to treat cancer, which is chemotherapy, and then you say that cancer is caused by chemicals. How come those chemicals are both the cause and the treatment of cancer at the same time? And also, how can radioactive material cause cancer and at the same time be used to treat cancer? How can it be the cause and the treatment?" (K, Int. 1)

Khalid saw that this student was questioning many points about chemicals, where some questions were beyond his chronological age. In terms of reasoning, Khalid indicated that students' reasoning could lead to new and unexpected questions. He recalled one example of students' reasoning that occurred when he was teaching generic information about heart diseases in class.

> One student asked why the cholesterol deposits on the artery walls. So I answered that this occurs because of smoking, since smoking increases the percentage of cholesterol in the blood. The student started asking how it is possible for smoking to cause this while the cigarettes do not contain any fat. What this student is saying is true as cigarettes do not have any fat; therefore, how would smoking increase cholesterol in blood? (K, Int. 1)

With respect to Khalid's students, participants believed that questioning and reasoning are methods that facilitate their creativity. In the focus group, two students referred to questioning as an inspiring approach to be creative.

> **Talal:** The teaching approach should help me question myself and then I ask my teachers.

Salman: Yes, it should help us ask the teacher questions … about something I do not know.

Talal: Even questions about something related to the lesson. (K, St.FG)

Talal sketched a particular classroom activity related to reasoning. He sketched himself with his friend doing an experiment to inductively reason the law of mass conservation.

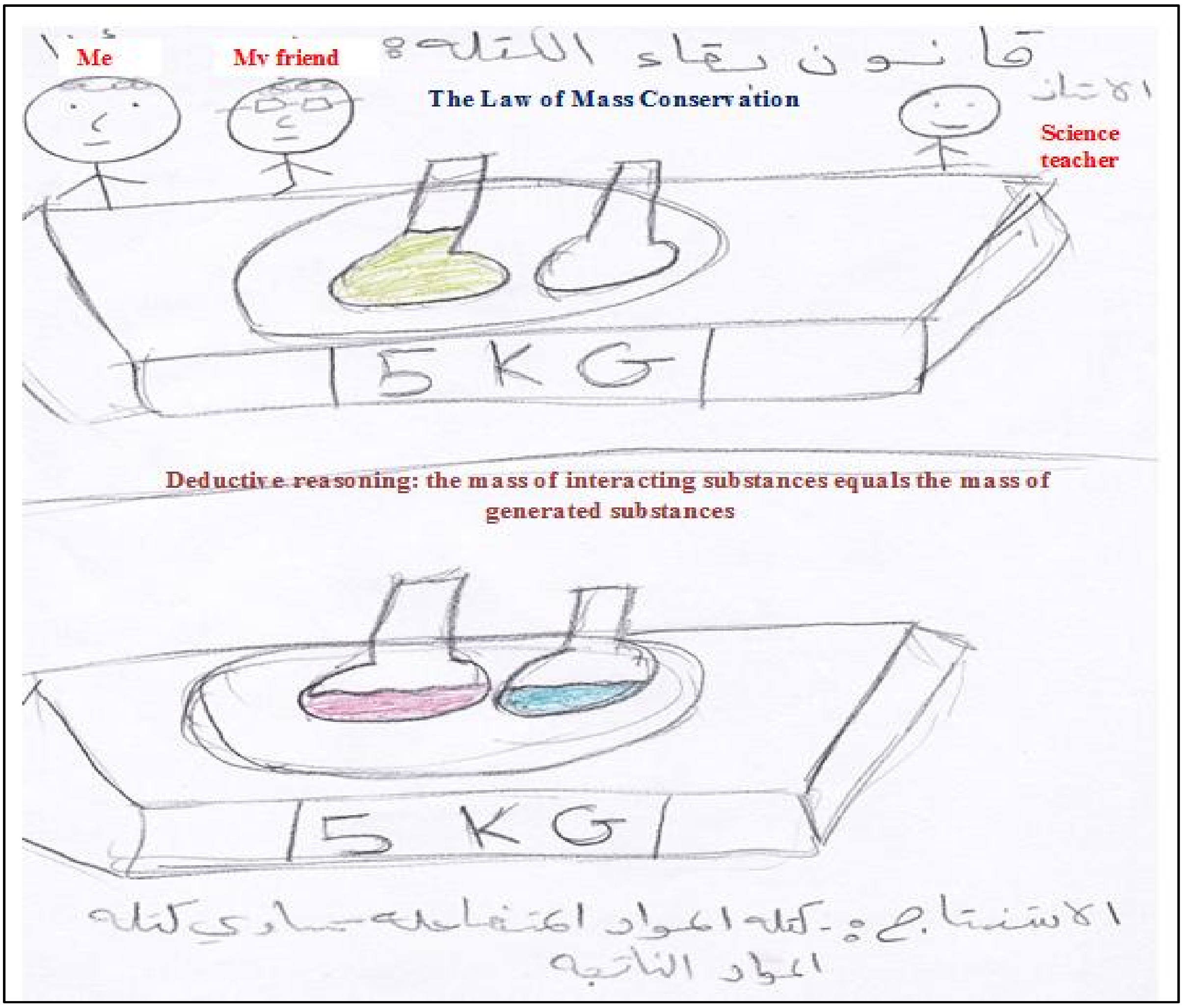


Figure 30: Student's drawing (K, FG, St. Talal)

Moreover, Khalid believed teaching creativity can be achieved through the inquiry approach “because it makes the students think” (K, Int. 2). Conducting experiments and group work could foster students’ creativity. Therefore, Khalid argued that “the most important thing is differentiating teaching practices” (K, Int. 1), where his differentiation of teaching approaches depended on the nature of the lesson’s topic.

With respect to his classroom practices, Khalid applied mixed practices, where his practices were neither totally traditional nor progressive. For example, Khalid asked his students to conduct the law of mass conservation experiment. He told them to be quiet and focus on doing the experiment because “this experiment will not be repeated and it will be one of the experiments included on the practical test” (K, Obs.4). Khalid’s interest stemmed not only from his belief in learning through experimentations, but also his desire for them to do the experiment to be ready for the practical exam.

In another example, Khalid used a guided enquiry question for each lesson plan. He included a “search more” section that consists of open questions to be investigated by his students. For example, Khalid wrote in the lesson plan of the first observed lesson: “You have learnt about the atom according to the experiments of two of the greatest scientists. Your task is to investigate the contribution of the Arabic scientist Ahmed Zewail, who won the Nobel Prize in 1999” (K, Obs.1). Nevertheless, Khalid confirmed that “science teachers write the ‘search more’ paragraph for every lesson. But for me, I would be lying if I say that I do this activity in every class. I do it, but not in every class” (K, Int. 2).

8.6.5 Reflection on Khalid’s case

As the data analysis indicated, Khalid held creativity-fostering beliefs and applied mixed practices, meaning that his case is mainly a progressive one. Khalid was dissatisfied with the current context, where he felt that there are a lot of constraints that need to be solved. He found that these constraints affect his personal life and much of his professional career as the current demands force him to do extra work at home to cope with the overloaded tasks assigned by the school and the system in general.

8.7 Brief reflections on case study findings

The classification process divided the cases into four groups according to their beliefs–practices relationship. Two cases demonstrated consistency between what they believe in and what they do in their classes; meanwhile, six cases showed that their beliefs were not in line with their practices. The levels of belief of the inconsistent cases were also more advanced than their practices, suggesting that external influences hinder the transfer of beliefs into classroom practices.

This leads to another point: the challenge of including pedagogical beliefs in the classroom context. The cases revealed that several constraints in the surrounding contexts play a role in making the pedagogical decisions of science teachers. Therefore, the teacher's beliefs encounter contextual constraints (see Chapter 7), which shapes practices because such a clash could lead to pedagogical decisions about which practices should be applied inside the science classroom.

Another role of the contexts is that the teachers referred to contextual events when they supported their professed beliefs. In other words, the teachers' beliefs were validated based on their previous or current experiences in terms of their interactions with their contexts. This indicates that the contexts (e.g., personal, academic, professional, classroom, school, science mentorship, societal) contribute to shaping the teachers' pedagogical beliefs. Overall, these reflections are deeply discussed in the next chapter, which aims to critically discuss the findings of both the thematic analysis and case study analysis.

Chapter Nine: Discussion of the findings

9.1 Introduction

The purpose of this chapter is to discuss the major findings in relation to the existing body of knowledge within the area of focus of the current study. Themes identified in the participants' voices and the fieldwork data are critically discussed and compared with results from the previous literature in order to demonstrate the relevance of the drawn conclusions of this study. A relevant starting point of this chapter is the research questions used to construct critical discussions and draw conclusions. Thus, I would reiterate the research questions as follows:

> Q1: What beliefs do science teachers hold about pedagogical approaches that foster creativity in the science classroom?
>
> Q2: What are the sociocultural factors that facilitate these pedagogical approaches?
>
> Q3: What are the pedagogical classroom practices of science teachers in Kuwaiti intermediate schools?
>
> Q4: How do science teachers perceive the sociocultural factors that mediate their pedagogical beliefs and practices to foster creativity?
>
> Q5: How consistent are science teacher's practices with their beliefs?

The answers were represented as thematic and case studies findings in chapters 6 through 8. The current chapter unifies the thematic findings with the case studies results to discuss the overall findings. Consequently, the chapter consists of several sections discussing the overall findings—namely,:

- Teachers' beliefs about fostering creativity in the science classroom
- Facilitating factors for fostering creativity in the science classroom
- Relationship between beliefs and practices
- The sociocultural influences on teachers' beliefs and practices

- a model of understanding the relationship of beliefs and practices through sociocultural perspective

Each section focuses on a specific subject and includes the relevant subheadings. For example, the first section discusses teachers' beliefs about creativity in general as well as their beliefs about fostering creativity in the science classroom. The second section discusses the facilitating factors that foster creativity in the science classroom. The third section compares teachers' beliefs about pedagogical approaches for fostering creativity to their applied practices. The fourth section is divided into three focuses to demonstrate the role of sociocultural contexts on teachers' beliefs and practices: 1) discussing the consistency and inconsistency levels between beliefs and practices; 2) discussing the sociocultural constraints as mediating factors between beliefs and practices; and 3) the relationship between sociocultural contexts and teachers' experiences. The final section aims to summarize the discussion and link it to the conclusion chapter to discuss implications, contributions, limitations, and suggestions.

9.2 Teachers' beliefs about fostering creativity in the science classroom

This section addresses teachers' beliefs within two areas. Firstly, it discusses teachers' general beliefs of creativity, including aspects, elements, potentiality, and models. Secondly, it discusses deeper and more sophisticated beliefs of fostering creativity in the science classroom.

9.2.1 General beliefs of creativity

The current study revealed teachers' beliefs about the meaning of creativity. For a brief illustration, all of the teachers iterated one or more of three concepts to define creativity—namely, originality, usefulness, and imagination. They considered something to be creative when it appeared to be original, useful, and imaginative. They also referred to creativity as an outcome, process, person, or environment, indicating that they are aware of different elements of creativity and were not restricted to only one of these elements. Teachers also mentioned their belief in the creative potential of their students by confirming that creativity is for all people, where every student has the potential to be creative. These beliefs are discussed and interpreted in relation to the previous literature.

To start with, the findings revealed three aspects for conceptualizing something as creative: originality, usefulness, and imagination. Originality as an example was mentioned by all teachers as well as the students who participated in the focus groups. Usefulness was mentioned by four teachers (Ali, Salem, Fahed, and Khalid). Zayed, Ali, Mohammed, and Salem also mentioned imagination to describe someone or something as creative. Such an understanding of creativity is in line with the descriptions stated by quite a number of creativity scholars, such as Feldman (1994), Amabile (1983), Sternberg and Lubart (1999), Lynch and Harries (2001), and Kampylis, Berki and Saariluoma (2009). Here I used the words “something,” “someone,” and “thing” because the interviewees could be referring to a product, person, process, or environment. The findings of the current study did not differentiate among the elements of creativity; rather, the participants referred to creativity as person, product, environment, or process in different occasions. The justification of teachers’ statements could be related to the relationship among the four elements. It can be argued that the elements are overlapping and interconnected to each other, creating interdependence among the four elements. This interpretation is supported by Taylor (1995), who strongly argued for the interconnection of the four elements of creativity.

Moreover, the current study found that 7 out of 8 science teachers were aware of the existence of the different models of creativity, as they strongly believed in creative potentiality and asserted that anyone can be creative, although there are different levels of creativity. None of the teachers except Jasser considered creative students to be gifted, exceptional, or more able students that need to be taught in special programmes. Jasser was the only one who referred to creative students as gifted and excellent students who should be segregated from a “normal class” and receive a “special curriculum.” Consequently, almost all science teachers valued students’ creativity according to the model of everyday creativity, which is also called a little “c” (Craft, 2002) or psychological creativity (Boden, 1990), rather than believing in the big “C” creativity (Craft, 2002), also known as historical creativity (Boden, 1990).

Overall, these findings are in line with creativity arguments and concur with western concepts of creativity, where most teachers stated similar beliefs that concur with the arguments derived from creativity literature. Thus, teachers' general beliefs about creativity within the current study are harmonized with western theories; this sort of harmonization could be related to the academic background based on teachers' education programmes in Kuwait. For example, most pre-service teachers taught at least two modules related to creativity and innovation, in which pre-service teachers studied psychological and social theories of creativity (Abdualwahab, 2008). However, this sort of harmonization does not mean that what is seen as creative within western concepts would necessarily be seen as creative within the Kuwaiti context and vice versa because the cultural background will value the meaning of usefulness, originality, and imagination of the "thing" (Brannigan, 1981; Craft, 2005, 2008, 2010; Lubart, 1999). One issue that needs to be taken into account is the meaning of creativity, including its aspects, models, and elements that can be seen as general beliefs. When more sophisticated beliefs of fostering creativity are researched, the data analysis showed different levels of beliefs among teachers. In other words, science teachers showed very evident similarities when they spoke about general issues regarding creativity, such as definitions, models, and elements; however, differences were also evident when they spoke about the deeper issues related to fostering creativity within the context of science. Therefore, the next subsection aims to discuss and interpret these differences.

9.2.2 Beliefs about fostering creativity in the science classroom

As previously discussed, the findings indicated nearly complete agreement among teachers in terms of creativity's definition, aspects, elements, and models. However, such an agreement did not emerge, when beliefs about creativity in science classroom were explored. In other words, the teachers appeared to hold different degrees of beliefs about fostering creativity within the science classroom. At which, three degrees of beliefs about fostering creativity in science were found: non-creativity-fostering (traditional), mixed, or creativity-fostering (progressive).

To illustrate this point, half of the teachers in the current study held creativity-fostering beliefs (Khalid, Fahed, Salem, and Ali), believing that creativity is embedded within the scientific subject. These teachers viewed creativity as a major component of the nature of their subject, which is in line with previous studies focused on fostering creativity in the science classroom (Hu & Adey, 2002; Johnston & Ahtee, 2006). As Johnston (2009) argued, teachers specializing in teaching scientific subjects such as science, chemistry, physics, geology, and math believe that creativity can be fostered in their subjects. Moreover, this finding contradicted the findings of other studies that concluded that teachers mainly relate creativity with arts such as visual arts and music subjects (Aljughaiman & Mowrer-Reynolds, 2005; Diakidoy & Kanari, 1999; Fryer, 1996; Kampylis, 2010; Mohammed, 2006).

In regard to the other four teachers in the current study, one held non-creativity-fostering beliefs (Jasser) and three held mixed beliefs (Omar, Mohammed, and Zayed). These teachers stated general beliefs about creativity, but they did not state a clear view about the relationship between creativity and science. With respect to previous research, several studies have reached similar conclusions in which science teachers hold general beliefs about creativity; these studies also concluded that science teachers could not demonstrate more sophisticated pedagogical beliefs of how creativity in science can be developed (e.g., Aljughaiman & Mowrer-Reynolds, 2005; Bolden, Harries, & Newton, 2010; Newton & Newton, 2008; 2009a; 2009b;2010). Thus, these studies indicated that science teachers' beliefs about fostering creativity in science are simple and general, concurring with the participants who held traditional and mixed beliefs (Jasser, Mohammed, Zayed, and Omar). A question remains as to why these four teachers did not profess creativity-fostering beliefs like the other four teachers.

Holding non-creativity-fostering or mixed beliefs about fostering creativity in science can be attributed to teachers' narrow view about the nature of science education and the nature of science (NoS). For example, teachers are more likely to view science education as static and valued by empirical facts; meanwhile, creativity is valued by subjective perspective more than by empirical facts, which might result in the emergence of naïve and simple beliefs about how to foster creativity in science education (Johnston, 2009; Osborne & Dillon, 2008). Thus, it seems that teachers with traditional and mixed beliefs lack an understanding about the nature of science education, which in turn indicates that they might have a lack of understanding about the NoS as well.

More specifically, I would argue here that science education is not static and value-free; rather, it is multifarious. For example, a number of scholars have empirically demonstrated that science education has a manifold nature rather than a static one, and it is seen as a creative subject by teachers (e.g., Johnston & Ahtee, 2006; Johnston, Ahtee, & Hayes, 1998; Koulaidis & Ogborn, 1989). The reason is that it refers to the components of NoS that include the creativity aspect. As Abd-Elkhalick and Lederman (2000) indicated, the NoS comprises five interrelated aspects: “(a) tentative (subject to change); (b) empirically-based (based on and/or derived from observations of the natural world); (c) subjective (theory-laden); (d) partially based on human inference, imagination, and creativity; and (e) socially and culturally embedded” (p. 1063). Abd-Elkhalick and Lederman added two aspects: “the distinction between observation and inference, and the functions of, and relationship between scientific theories and laws” (p. 1063). Teachers’ understanding of these aspects has a great influence on their pedagogical beliefs and behaviours toward science teaching and learning (; Bell, Lederman, & Abd-Elkhalick, 2000; Mihladiz & Dogan, 2014; Tsai, 2002). Therefore, it is suggested that science teachers should be more knowledgeable of these aspects and have a deeper understanding about NoS aspects to demonstrate effective pedagogical beliefs and practices in their classes (Abd-Elkhalick & Lederman, 2000).

Therefore, the current study relates the emergence of naïve beliefs of fostering creativity in the science classroom (Jasser, Mohammed, Zayed, and Omar) to the teachers’ lack of understanding of both the nature of science education and the NoS aspects because creativity is a major aspect of NoS. Consequently, this implies the need to address NoS issues to science teachers through different teacher education programmes. When teachers misunderstand the nature of the taught subject, it is more likely to be deficiently delivered and taught inside the classroom. Thus, teacher education programmes need to reconsider the importance of teaching science teachers (pre- and in-service) not only creativity subjects, but also all seven aspects of NoS.

9.3 Facilitating factors for fostering creativity in the science classroom

The results pointed out different facilitating factors to foster creativity in the science classroom. The factors were divided into three categories—namely, educational setting-related factors, science teacher-related factors, and student-related factors. In this section, the facilitating factors within each category are discussed. This is then followed by a discussion to address the interrelationship among these factors.

9.3.1 Educational setting-related factors

The emerging factors under this category include encouraging personal teachers' and students' freedom, providing sufficient time, making external motivation available, and integrating ICT. The teachers believe that the facilitating factors related to the educational setting are uncontrollable by them. Rather, the policymakers of the educational management should suit these facilitating factors within the educational system.

The teachers emphasized these factors associated with educational management, where they as teachers cannot control and support them. The reason for believing that these factors do not fall under the teacher's management could be the nature of the Kuwaiti educational system, which is based on a centralized approach to education. The Ministry of Education has the authority to shape the educational curriculum and syllabus, providing textbooks and materials, setting general educational goals, setting assessment criteria, and so on. Meanwhile, the teachers believed that they are at the bottom of the educational pyramid, and their voice is omitted in terms of forming regulations, goals, and plans. Therefore, the teachers believed that these facilitating factors can be supported by educational policymakers and senior science mentors at the Ministry of Education who are at the top of the educational pyramid in Kuwait. Here, I shall discuss these four factors in greater detail.

9.3.1.1 Providing sufficient time

In order to perform creatively or reach a creative outcome, students need to have adequate time to interact with the assigned activity. According to Sternberg and Williams (1996), providing sufficient time is a chief factor to foster creative endeavours of students; such an assertion was mentioned in all the teachers' interviews in the current study. The importance of providing sufficient time could relate to the open nature of the creative process that requires a degree of flexibility, including a flexible period of time. For example, some teachers (Fahed, Jasser, and Salem) argued that fostering creativity could require long-term tasks, where the students could immediately manifest creative ideas during the session or might take a day, a week, or more.

According to the literature, creativity is associated with open questions, where questions such as "what if?" are asked (Craft, 2001). Such questions need an open period of time because there are no direct answers; rather, they force the students to think outside the box and use their imagination to offer original and valuable responses. Students need time to come up with something that is original and unknown for them. The need for sufficient time has been considered by other researchers (Claxton & Lucas, 2004; Cremin et al., 2006; Jeffrey, 2005), who empirically proved that teachers have to offer enough time for their students to be ready to take risks and deal with uncertainty.

A question could be raised here regarding the definition of "sufficient time"; I think that the provided time is more contextual and inter-subjective matter, where the teacher and his/her students can set a timetable for each task according to their needs. This point is in line with the findings of Cremin et al.'s study, which concluded that "time and space were viewed as permeable resources which were stretched and flexed in response to the children's needs and their emergent learning. Time to think, imagine, ask questions, experiment and reflect upon work in progress was seen as central to enabling the young learners to possibility think their way forwards" (2006, p. 116). Consequently, another question raised here focuses on the teacher's capacity to offer sufficient time for his/her students. Frankly, the literature indicated that creativity-fostering teachers should hold a degree of flexibility and freedom to simultaneously follow the educational syllabus and facilitate students' creativity by offering enough time (Halpin, 2003; Sternberg, 1999). Thus, this facilitating factor leads to other factors emerging in the study that encourage the personal freedom of teachers as well as their students.

9.3.1.2 Encouraging professional freedom and autonomy

Encouraging professional freedom of both science teachers and students is iterated many times during the data collection phase. All the teachers held strong beliefs about the power of having freedom during the activities to form creative outcomes. They also connect their own freedom to their students' freedom as a synchronized relationship. In other words, the degree of freedom offered for the students by their science teachers depends on the degree of the teacher's freedom offered by the educational system.

With respect to teachers' freedom, this finding indicated that teachers' autonomy should be supported by the system, thereby enabling the teacher to freely form pedagogical decisions for the sake of fostering their students' creativity. Nevertheless, the teachers believed that the system does not support their autonomy; rather, the system creates a structured environment that narrows the teachers' capacities to make pedagogical decisions. For example, teachers viewed the system's demands and expectations as constraining factors that limit their pedagogical choices, such as following restricted syllabus plans, teaching the ideas from science textbooks, doing overloaded administrative tasks, and offering insufficient time. These constraints will be elaborately discussed later in this chapter. In relation to the previous knowledge, this finding is consistent with recent research undertaken in Kuwait (Alkharas, 2013), which concluded that teachers believed that their professional freedom is indispensable as a facilitating factor to foster creativity in the classroom as well as facilitate creative teaching because, when the teacher's autonomy is encouraged, new pedagogical ideas can be implemented. It also helps when the teacher is more flexible with a curriculum-laden course. However, Alkharas found that the educational system restricts teachers' decisions by setting fixed rules, goals, and plans (2013).

In regard to students' freedom, the science teachers believed that students should freely interact with classroom activities. Students must feel free to share their views about tasks, make decisions, and use tools and lab materials. Meanwhile, the teacher should be a supervisor instead of controlling the students' interactions, as evidenced by other research in different cultures (Ewing & Gibson, 2007; Haring-Smith, 2006; Mohammed, 2006). The importance of allowing the students to freely participate within the classroom activities could strengthen the students' autonomy, which in turn could enhance the creative potential of the student. The same point is emphasized by Jeffry and Wood (1997), who conducted a study that involved 140 students to explore their perspectives of the creative classroom environment. Jeffry and Wood's study identified four aspects of the creative classroom according to students' attitudes; encouraging students' autonomy is one of these aspects. It also concluded that more creative endeavours were found in classrooms that support students' autonomy and encourage personal freedom (1997).

9.3.1.3 The availability of extrinsic motivation

The findings revealed that extrinsic motivation is needed for fostering creativity, and it can ensure the continuity of manifesting creative endeavours. Both creative students and creativity-fostering teachers need to be rewarded by the educational system. This finding is in line with other studies (Haring-Smith, 2006; Eisenberger & Shanock, 2003; Eisenberger & Rhoades, 2001; Lew & Cho, 2013), which concluded that recognising and rewarding creative behaviours would lead to more creative endeavours by the students. Also, Sternberg argued that motivating creative students would ensure continuous efforts to manifest creative performance (2006). However, when reviewing creativity literature, it becomes obvious that there is a disagreement about whether extrinsic rewards facilitate individuals' creativity or not. For example, Amabile (1996) strongly argued that external rewards decrease the intrinsic motivation of individuals who demonstrate creative actions, which in turn will negatively affect the consequent actions to be less creative ones. Moreover, other empirical works have demonstrated that there is a weak or insignificant relationship between rewards and creativity (Baer, Oldham, & Cummings, 2003; Joussemet & Koestner, 1999).

It might be true that there is conflicting empirical evidence regarding to what extent extrinsic motivation facilitates or exacerbates creativity in the classroom, however, I would argue here that it is necessary to acknowledge and appreciate the creative endeavours of both teachers and students to distinguish creative efforts from non-creative efforts. If rewards are applied for both creative and non-creative actions, they might not encourage people to show creative endeavours. Thus, I agree with Eisenberger and Shanock (2003), who argued that when rewards are used on a daily basis to encourage normal achievements, they decrease individuals' intrinsic motivation to be creative, which could lead to more temptations to achieve something conventional. Meanwhile, when rewards are limited for creative accomplishments, they increase intrinsic motivation and creativity. For example, it is common for school administrations in Kuwait to reward excellent students who achieve 90% or more on their annual and semester examinations; meanwhile, there is no such reward for students who demonstrate creative performance. Therefore, rewarding and acknowledging creative performance need to be considered by educational policymakers in Kuwait to encourage students and teachers.

93.1.4 Integrating ICT

All the teachers mentioned the effectiveness of integrating ICT in science laboratories to foster creative interaction. The teachers confessed that ICT plays a positive role in attracting students' attention toward learning science and strengthening a positive attitude toward being creative in the science classroom. The teachers also believed that, when students are able to use ICT to learn science, they can apply their new ideas in a virtual environment that offers a great opportunity for manipulating the variables and exploring the effectiveness of their original ideas. The reason for this is that ICT features create virtual realities under students' control, which make them able to "turn ideas into working models" (Wegerif, 2010, p. 110).

Teachers' beliefs are consistent with recent arguments and research within creativity as well as science education literature. For example, the result indicated that ICT is great help for increasing the quality of learning science; this concurs with the argument of Warwick, Wilson, and Winterbottom (2006), who stated that the use of modern ICT such as interactive boards can create open discussions among the students, enabling them share and explore the focused subject. Consequently, this can enhance the quality of learning in science education (2006). It also shifts the learning approach from teacher-centred to student-centred (Boyd, 2002). By supporting student-centred learning through the application of ICT, students are more likely to develop their science understandings by talking and sharing thoughts and suggestions (Warwick, Wilson, & Winterbottom, 2006).

More specifically, the findings revealed that integrating ICT in the science classroom would facilitate the application of pedagogical approaches that foster students' creativity. In the literature, Williamson discussed the relationship between applying ICT and fostering creativity in the science classroom. He addressed the role of ICT in the science classroom as a facilitating factor for fostering students' creativity because it can enhance interactivity; it "can also encourage pupils to pose exploratory 'what-if' questions" (2006, p. 74). Hence, the teachers argued for comprising ICT devices in their pedagogical approaches to increase creative engagement inside the classroom.

Science laboratories in Kuwaiti schools are already equipped with some ICT devices, but the teachers asked for more modern technological facilities. It is worth noting here, however, that integrating ICT in the science classroom could be applied for different goals and not essentially for fostering creativity. As the current study found, interactive boards, overhead projectors, computers, and smart phones were frequently applied when the teachers gave lectures and conducted teacher-centred activities. The students appeared to be passive recipients when ICT is applied. In the observed lessons in which ICT did not increase students' interactivity, students were only a silent audience who watched and listened to teachers' presentations through ICT devices. Therefore, integrating ICT not only refers to the availability of modern technological objects, but rather should be seen as an opportunity for active engagements and new scopes for creative communications among students. Therefore, asking educational policymakers to equip science laboratories with more modern ICT is not enough; rather, it should combine training courses to educate the teachers about how to effectively integrate ICT in their lessons.

9.3.2Teacher-related factors

Three factors emerged as part of the science teacher's role and responsibility, which include creating a friendly classroom, diversifying teaching approaches, and linking informal and formal science learning.

9.3.2.1 Creating friendly and warm classrooms

The current study found that science teachers believed that building up friendly relationships with their students would help them manifest creative actions during the classroom activities. According to the literature, it is the teacher's role to prepare an appropriate classroom in which students can feel comfortable expressing their unusual ideas without being afraid of teachers' assessment and evaluation of these ideas. Creative actions would emerge when a respectful, friendly, non-judgmental relationship exists between the teacher and her/his students (Davis & Rimm, 1998). This finding fits with those of other studies (Haring-Smith, 2006; Mohamed, 2006).

However, the findings challenge the current types of the teacher–student relationship in the Kuwaiti educational system; it was evident that the teachers are authoritarians in the current study. Teachers control most of the classroom's interactivity; meanwhile, the students' voices were less obvious. One of the possible interpretations of being authoritarian teachers is that the fear of losing or abdicating some of their responsibilities. For instance, teachers may feel that being friendly and non-judgmental at the classroom would lead to sharing pedagogical decisions with their students (Jarwan, 1999); which in turn limits their authority inside the class. Another possible interpretation could be related to the cultural custom of the Kuwaiti context, where the older has to be more respected by youngers. This interpretation is in line with the conclusion of Mohamed's study (2006), which argued that the teachers were authoritarians because the teacher-student relationship is based on leadership in the Bruneian culture; where the teacher is the leader and the students' needs to follow his/her orders.

As Jarwan (1999) argued, despite valuable efforts to enhance the educational system in the Arab world to foster creativity and thinking skills, the relationship between teachers and their students is still fundamental because the teacher is seen as the source of knowledge and the only one who has authority and control in the class and who asks questions and judges answers. Such a relationship does not encourage creative learning, but it facilitates the process of following the teacher's instructions (Abdul-Aziz, 2008). Thus, the teacher–student relationship should be friendly and non-judgmental to freely enable the students to share and discuss their new possibilities instead of thinking of one correct answer (Abdul-Aziz, 2008; Jarwan, 1999; Mohamed, 2006).

9.3.2.2 Diversifying teaching approaches and activities

Teachers believed that diversifying classroom activities is a facilitating factor for fostering creativity in the science classroom. Indeed, 7 out of 8 teachers supported the use of multiple pedagogical practices instead of repeating one pedagogical practice every session. The teachers' assertions and statements made a connection between diversifying activities and preventing the students from feeling bored with the science lesson. Rather, they keep the students motivated and interested about the assigned activities and increase their tendency to participate within classroom practices. The literature did not show considerable evidence supporting the positive effects of diversifying pedagogical practices on students' creativity. However, this factor is consistent with the findings of a study undertaken in Kuwait by Sayar et al. (2009), which concluded that Kuwaiti educators—including teachers, head teachers, monitors, and academicians—agreed that diversifying the teaching approach is an important aspect to foster creative thinking skills.

Therefore, I thought of two possible explanations to enlighten the importance of teachers' diversification. My first argument is that diversifying pedagogical practices gives the students unexpected and unfamiliar experiences as they are not engaging in particular practice frequently repeated and applied by the teacher. Such unfamiliar experiences would encourage students to think differently and engage actively within the classroom. According to Ritter, Damian, Simonton, van Baaren, Derks, & Dijksterhuis (2012), people are more likely to be flexible and open to experiences when they are situated in unexpected experiences and activities, which in turn enhance their creativity. Thus, the teachers' beliefs could stand on this argument, as diversifying practices are important for enabling the students to experience new and unfamiliar activities.

The other possible explanation is that teachers believed that adopting similar types of pedagogical activities every lesson causes the students to lose interest in science and become inactive participants during the lesson whereas diversifying classroom practices keeps students enthused and interested about science learning. The findings further revealed that students' interest in and curiosity toward science appeared to be a significant facilitating factor for fostering students' creativity. Thus, keeping students interested and curious about science classroom activities is a significant factor. According to Talib, several empirical works concluded that producing creative outcomes depends on individuals' interest and curiosity; he added that "the interesting evidences that are derived from the theories and empirical works indicate that creative persons engage into the task when they feel it is satisfying and enjoyable" (2009, p. 2). These two explanations support the need to diversify approaches within the science classroom as a facilitating factor.

9.3.2.3 Linking informal and formal science learning

One of the emerging factors is encouraging informal science learning. Seven out of eight teachers believed that teaching science as a daily life subject is a strong facilitating factor to manifest creative actions within indoor or outdoor activities. They believed that science teachers should connect formal learning with students' local context, current social issues, and outdoor learning opportunities.

The significance of promoting informal science learning and linking it with formal science learning could stimulate students' intrinsic motivation because such informal learning "is self-motivated, voluntary, guided by the learner's needs and interests, learning that is engaged in throughout his or her life" (Dierking, Falk, Rennie, Anderson, & Ellenbogen, 2003, p. 109). Hence, teachers believed that science should be taught as daily life subject instead of a segregated subject of students' outdoor experience and activities. As witnessed in Lloyd, Neilson, King, & Dyball's (2012) study, informal science learning offers an enjoyable experience, meets students' interests, and increases students' curiosity toward formal science learning. I would argue here that this facilitating factor plays an indirect role in fostering students' creativity as it stimulates students' specific individual characteristics seen as required for being creative, such as being curious and interested about the taught subject.

9.3.3 Student-related factors

Students also have to possess facilitating attitudes and behaviours in order to be creative. Teachers' beliefs indicated that being a curious student and being interested in science are significant facilitating factors for fostering creativity in the science classroom. The other facilitating factor is being a risk taker who demonstrates commitment and tolerance for dealing with ambiguity and uncertainty.

The existence of these individual aspects facilitate creative production, thereby encouraging aspects such as curiosity, risk taking, and tolerance to ambiguity in order to lead to more creative interactions and outcomes (Talib, 2009). Being an interested and curious risk taker who is tolerant to ambiguity is commonly identified by creativity writers and researchers as characteristics associated with creative people (e.g., Burnard et al., 2006; Dacey, 1989; Feist, 1998; Starko, 1995, 2001; Tardif & Sternberg, 1988; Taylor, 1995; Torrance, 2004;).

For example, almost all the teachers focused on students' curiosity and interest; they argued that not being curious about science minimizes students' creative potentiality and discourages teachers' tendencies to apply pedagogical practices for the sake of supporting students' creativity. According to the literature, individual curiosity is considered to be an inner drive of human efforts and endeavours to generate creative solutions and productions (e.g., Beetlestone, 1998; Kashdan, 2002; Reio, Petrosko, Wisewell, & Thongsukmag, 2006). I would argue here that this inner drive could stimulate students to question the taught subject within the science classroom and pose queries to explore more and expand their knowledge about it. In fact, Csikszentmihalyi argued that the starting point for generating creative outcomes is being curious because curious individuals instigate suspicions toward the transmitted knowledge and information as well as arouse actions to find different and original results (1996).

Bearing in mind the importance of students' curiosity, the findings revealed another factor: being a risk taker who is tolerant to ambiguity. Being a risk taker helps students actively engage in activities that require unfamiliar outcomes; therefore, students should be tolerant to experiencing a degree of uncertainty when asked to participate in creativity-fostering activities. This factor was confirmed by several empirical studies that linked being a risk taker with creative performance (e.g., Dewett, 2007; Shin & Zhou, 2003; Tierney, Farmer, & Graen, 1999; Zhou & George, 2001). The teachers admitted that all students have the potential to be creative; however, this potential depends on these individual aspects in relation to science, such as being curious about science and tolerant to ambiguities when they do scientific activities. Therefore, both teachers and policymakers need to reconsider how to encourage students' curiosity and enhance their tolerance to participate in more complex tasks based on higher thinking skills, including creative thinking skills.

With respect to the discussion of the second research question, a question could be raised regarding how these facilitating factors contribute to the existing body of knowledge. Frankly, a significant point needs to be addressed here: The identified facilitating factors are strongly interrelated, as represented in Figure 31, as the teacher-related, setting-related, and student-related factors are interconnected and complementary.

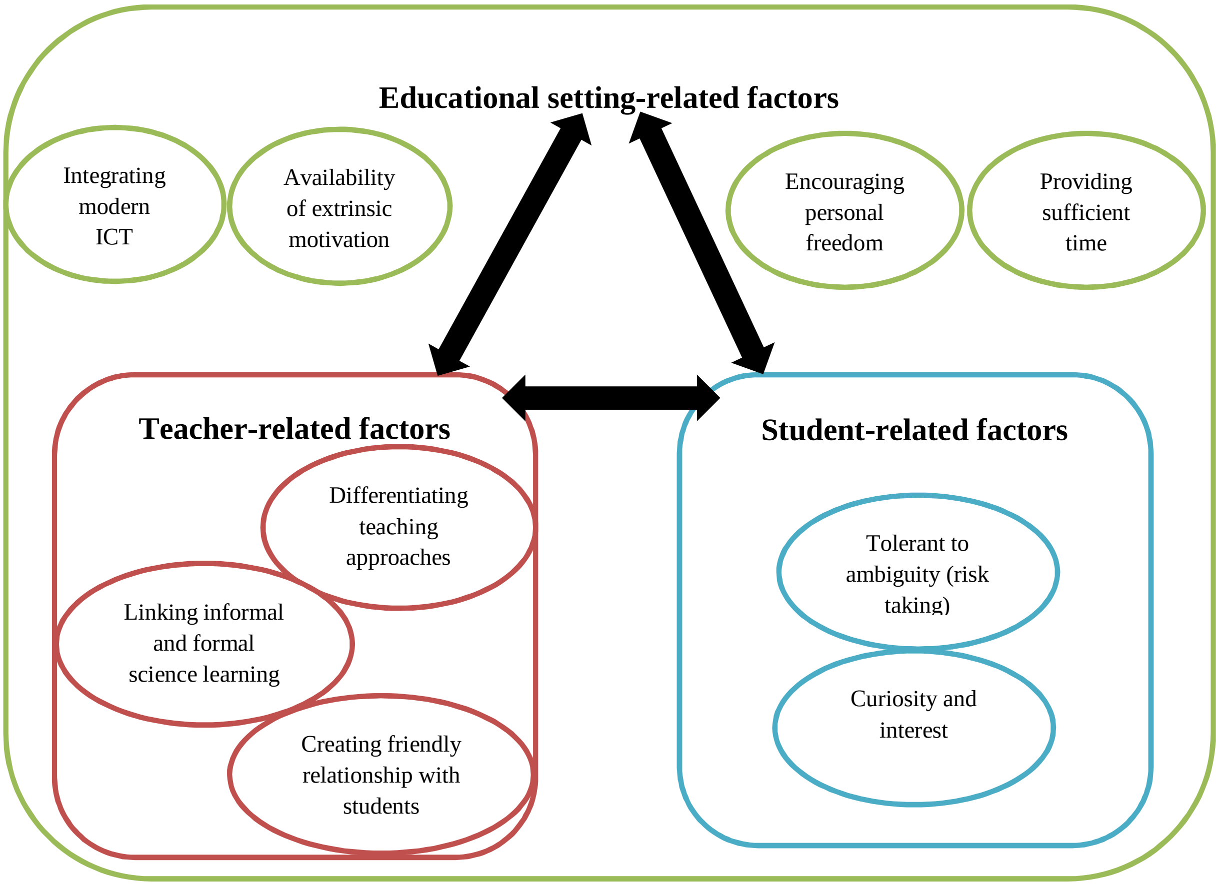


Figure 31: Facilitating factors for fostering students' creativity in science classroom

For example, science teachers could become facilitators for fostering creativity when they feel free to construct and diversify classroom activities. Teachers indicated that they can create friendly relationships and encourage students' autonomy if they have a degree of flexibility when teaching science content with less restriction. The teachers need a flexible timetable to link formal with informal science activities and to think of creative and new teaching practices in order to stimulate students' curiosity toward learning science. The teachers also indicated that the availability of ICT adds more opportunities to foster a creative learning environment; thus, they asked for more modern technology in their laboratories. The findings further showed that teachers cannot foster creativity if their students are not interested in or curious about learning science. Hence, teachers must keep students motivated and actively engage them with new experiences and activities by rewarding and motivating their creativity. The findings also revealed that students are very familiar with new technology; therefore, integrating ICT would attract students and enhance their sentiments toward science while enabling them to be more creative during classroom activities.

Therefore, the current study argues that fostering creativity in the science classroom is not only based on teachers' practices and support; rather, it requires mutually dependent factors, where science teachers, students, and policymakers work to mutually ensure the inclusion of specific factors in the science classroom. In other words, fostering creativity in the science classroom depends on the availability of simultaneous involvement among decision makers (e.g., science mentors), teachers, and students, in which each one of them ensures their related facilitating factors to prepare the appropriate circumstances for applying pedagogical approaches that foster students' creativity. Consequently, the current study suggests that these facilitating factors can be brought into the science classroom through collaborative coordination between educational decision makers and teachers to negotiate goals, demands, expectations, and needs. This suggestion also limits science teachers' negative feelings about being isolated from participating in forming educational decisions, rules, goals, and curriculum plans; meanwhile, such collaborative coordination can be a great opportunity to encourage teachers' autonomy to share their perspective and provide practical feedback from their classrooms.

9.4 Pedagogical approaches for fostering creativity in the science classroom

Teachers' practices are revealed through classroom observations, post-observational interviews, and students' focus groups. The findings revealed four pedagogical approaches that are believed by teachers to be appropriate for fostering students' creativity in science classrooms: teaching thinking skills, teaching through cooperation, teaching through scientific experiments, and teaching through scientific inquiries. The findings also revealed that the teachers believed that the science teacher can apply more than one approach at the same time. This section discusses these four pedagogical approaches in terms of teachers' beliefs and practices.

9.4.1 Fostering creativity through teaching thinking skills

In terms of teachers' beliefs, the findings indicated that teaching scientific thinking skills such as questioning and reasoning skills can foster students' creativity and enhance individuals' potential to be creative in science. Seven out of eight teachers mentioned that teaching students how to question and reason things are major skills for being creative in science. Teachers were not the only ones to mention questioning and reasoning; even students from different focus groups believed in these skills. Further, four teachers believed that brainstorming and problem solving skills should be taught and implemented because they help in generating ideas.

This finding does not differ from those from other studies. For example, Haigh (2007) concluded that questioning skills should be developed for the sake of generating creative outcomes. Cremin et al. (2006) concluded an empirical model of pedagogy for fostering possibility thinking, where posing questions appeared to be a core element of the model. Cremin et al.'s (2006) study served as a starting point for a series of empirical investigations documenting this model (i.e., Burnard et al., 2008; Chappell et al., 2008a, 2008b; Craft et al., 2012a, 2012b); all these studies found that questioning is a core element for fostering possibility thinking. Consequently, questioning is a core element for fostering creativity because possibility thinking is the heart of the little "c" creativity (Craft, 2000, 2001). Similarly, the literature showed that reasoning is a significant skill for reaching a creative outcome (e.g., Sternberg & Williams, 1996). Deductive and indicative reasoning skills are as important as questioning skills because they might lead to posing further questions or reaching new conclusions. For example, Khalid, Ali, and Salem provided real examples of students who reason the taught information, then pose a series of questions. Thus, the teachers strongly believed in the role of developing thinking skills. As evidenced by other research, there is an obvious relation between teaching thinking skills and fostering creativity (Shayer & Adey, 2002; Starko 1995; Sternberg, 2006).

Problem solving and brainstorming are additional skills based on systematic steps to generate original ideas and solutions. Such systematic steps are known as generating idea techniques (Croply, 2001). Four teachers (Zayed, Ali, Salem, and Jasser) believed in problem solving and brainstorming skills. Although the other four teachers did not mention problem solving or brainstorming, several studies examined the effects of these skills on students' creativity and identified positive relationships (Cheng, 2010). Such skills allow students to interact with open-ended problems and find varied solutions, thereby enabling them to verify the solution and choose creative ones, as evidenced in previous empirical works (Clow et al., 2011; Gallagher, Sher, Stepien, & Workman, 1995; Gallagher, Stepien, & Rosenthal, 1992; Park & Seung, 2008).

Nevertheless, teaching thinking skills was not evident in terms of teachers' practices within regular science classes. Students' questions are usually posed when the teacher allows the students to ask questions. For example, teachers did not promote questioning skills; rather, it was obvious in some observed lessons that the teachers refused to discuss students' questions that fell outside the lesson's content. Similarly, reasoning, problem solving, and brainstorming were absent within these classes.

9.4.2 Fostering creativity through cooperation

The second approach is teaching science through cooperation. Cooperative interactions such as group work, scientific dialogues, and playing were revealed in this study; hence, these approaches are compared and discussed in terms of teachers' beliefs and practices.

9.4.2.1 Group work

According to teachers' beliefs, seven out of eight teachers believed that group work activities create a suitable atmosphere for creative interactions among their students. Moreover, group work was a primary topic discussed by the students who participated in the focus groups by expressing their views verbally or in drawings. The teachers' beliefs about the great role of group work on students' creativity concur with the findings of other studies (Felith, 2000; Fernandez-Cardenas, 2008; Haigh, 2007; Leach, 2001; Miell & Littleton, 2004; Mohamad, 2006). Group work is considered to be an effective approach for exchanging original ideas and negotiating the usefulness of these ideas, which in turn facilitates collective interactions among students and manifests more creative ideas and solutions (Craft et al., 2008; Rietzschel, De Dreu, & Nijstad, 2009).

Yet group work activities were moderately applied in the observed classes, and some teachers prepared collective tasks and assigned their students into 5 or 6 groups (i.e., Khalid, Omar, Fhaled, and Salem). Nevertheless, the observed work groups were always guided by the teachers and prepared for close-ended activities, in which each group was asked to follow certain instructions to achieve specific targets in a specific period of time. I would argue here that such practices do not foster students' creativity because they are restricted by the teacher's control of students' interactions within the groups. Encouraging students to initiate group discussions was absent during the observed group works; indeed, some teachers appeared to be annoyed when the members of a group spoke to one another. However, many writers noted that discussions and negotiations within the group are the basis for encouraging collective endeavours and producing creative outcomes (Craft et al., 2008; Sternberg & Williams, 1996; Rietzschel et al., 2009).

9.4.2.2 Scientific dialogues

The findings indicated that 7 of the 8 teachers believed that creativity can be fostered by creating dialogic opportunities, where the given information is shared, discussed, questioned, and negotiated by the students as much as the teacher. In addition, students who participated in the focus groups highlighted the positive outcome of participating in cooperative activities, where they can talk and help each other in their science learning. Several authors and researchers have reinforced these beliefs about dialogues. An early example of such support is the key findings from Malaguzzi's (1993) study based on a series of classroom observations, which found that creativity can be fostered when there is space for interpersonal exchange in which students discuss, compare, conflict, and question ideas and perspectives. Dialogues that enable students to think together can foster creative and successful interactions and talks in both convergent and divergent tasks (Wegerif, 2012).

In terms of the observed practices, it was obvious that the teachers do most of the talking in the first place, although classroom dialogues were noted in some cases. Still, the observed dialogues were limited to teacher–student conversations whereas student–student conversations were almost absent or poorly implemented. The post-observational interviews with teachers indicated that restricting student–student talks stemmed from teachers' concerns about losing control and time, failing to deliver lesson information, and encouraging off-task talk instead of on-task talk. Therefore, teacher–student dialogues were more often applied than student–student dialogues, where it can be easily noted that the teacher posed on-task questions to which students have to respond. Such observed practices differ and are inconsistent with what the teachers stated as beliefs as well as with recent arguments that appeared in the literature. For example, Wegerif (2010) argued that creative talk not only emerges within on-task talk, but also within off-task talk; thus, he suggested that such interactions should be not dismissed because they consist of playful talk in which students play with words and are imaginative during the conversation. Wegerif (2010) also argued that such dialogues should be based on a questioning way of talking to liberate open questions and multiple responses. As evidenced in other research (e.g., Edward & Springate, 1995; Mohamed, 2006), dialogues that comprise questioning can facilitate divergent thinking and lead to more valued creative outcomes.

9.4.2.3 Playing

Playing as a cooperative approach was identified by only three teachers (Fahed, Ali, and Zayed), who made the connection between creative learning and playing. Playing is not supported by most of the teachers when compared to other cooperative approaches, such as group work and scientific dialogue, and empirical evidence supports this belief (e.g., Bonawitz, Shafto, Gweon, Goodman, Spelke, & Schulz, 2011; Burnard et al., 2006; Cremin et al., 2006; Jeffrey, 2004; Poddiakov, 2011). These studies concluded that playing within an exploratory classroom environment fosters creative learning and interactions. Playing helps students be imaginative and go beyond reality; it offers great opportunities to manipulate ideas and interact with different possibilities (Craft, 2000; Craft, 2001). However, the observed classroom practices did not indicate any kind of playing activity. Even the three teachers who believed in fostering creativity through playing did not demonstrate playful activity at all.

One of the possible interpretations of why playful activities are not applied is the chronological age of their students, who are teenagers (from year 6 to year 9). For example, the teacher Fahed stated that playing is an effective approach for the sake of creativity if it is applied for year 6 students because they are in the early years of being teenagers (F, Int. 1). Most of the studies and arguments discussing the relationship between playfulness and creativity focus on primary education students. Thus, playing could be more effective when applied for children rather than teenagers. Another possible interpretation of the absence of playful activities could be related to the confusion about which form of playing can foster creativity, as Craft (2000) acknowledged such confusion and argued that not all playful activities foster creativity. She stated that one kind of playing is based on imitation, where students imitate others, such as adults or cartoon characters; the other form is based on imagining new possibilities, where the students manipulate playful ideas. The former is beneficial in terms of enhancing students' social and personal developments; meanwhile, the latter helps the students to be imaginative and demonstrate creative behaviours.

9.4.3 Fostering creativity by conducting scientific inquiries

Another approach that emerged in this study is teaching by conducting scientific inquiries, such as guided and open inquiries. All the teachers appreciated the process of conducting inquiries to investigate specific issues and draw new conclusions for the inquirers; they believed that such an approach fosters creative actions and thoughts. Frankly, fostering creativity by conducting inquiries, especially open inquiries, is widely acknowledged within the educational field (Craft, 2000; Johnson, 2000; Meador, 2003). This is a recommended approach for enhancing the imaginative and creative abilities of students who study science (Cheng, 2006; Kind & Kind, 2007) because, when it is applied, students will creatively engage with the processes of conducting scientific research (Craft, 2000; Meador, 2003; Starko, 2010). The findings of this study not only concurred with writers' arguments, but also with previous research, such as Cheng (2010), Haigh (2007), and Felith (2000). For example, Felith (2000) conducted a qualitative study and interviewed seven science teachers; the results indicated several pedagogical practices for fostering students' creativity, including scientific inquiry. Cheng (2010) also examined the effects of scientific inquiry on students' creativity. She conducted multiple case studies and found that open inquiry, problem solving, and creative writing are effective approaches to foster students' creativity in the science classroom.

Nevertheless, the observed practices differ from teachers' beliefs and these previous studies. Learning through inquiry was mildly applied in the classrooms, where I noted few activities based on guided inquiry. The guided inquiry was noted because it is a compulsory activity for each lesson: Science teachers are asked as a part of the science curriculum to prepare open questions to be researched by the students. The majority of the teachers prepared open questions in their lesson plans, but they did not address them during the lesson on a regular basis. They complained about the lack of time and the huge curriculum requirements; as a result, they did not attempt to ask students to research answers to open questions. They felt that this compulsory activity overloaded the class time and so they simply could not apply it every time. Meanwhile, open inquiry was completely absent in the observed lessons and was noted only during the extracurricular activities within each case study. This activity was limited to a small number of students who expressed new ideas and wanted to conduct long-term projects. Therefore, the majority of students did not have the chance to engage in such activities.

9.4.4 Fostering creativity by conducting scientific experiments

The final approach is teaching by conducting scientific experiments. All the teachers emphasized that such an approach enables the students to create something original and useful. Teachers' beliefs about students conducting experiments is in line with the view of science education writers (Cheng, 2006; Haigh, 2007; Kind & Kind, 2007; Shayer & Adey, 2002), who support the need to foster students' creativity within lab activities based on experiments. Experiments and practical lab activities were also coded for all 8 focus groups, and both students and teachers emphasized it as an effective way to stimulate practice for being creative students in the science classroom. It could be argued that sensory and psychomotor skills (e.g., thinking and communication skills) can lead to creative performance in science. Conducting experiments provides significant practice for any scientific inquiry. Therefore, science teachers found that these practical activities offer great opportunities to demonstrate creative actions. This finding concurs with findings from other research (e.g., Newton & Newton, 2008, 2010) that concluded that science teachers believed that students conducting experiments nurtured their creativity.

With respect to the observed experiments, it is appeared that teachers are textbook-oriented in terms of conducting scientific experiments, as they implemented only the practical activities stated in the science workbook. Moreover, they intensively focused on experiments that were more likely to be included in the practical text. Nevertheless, the observed experiments were not trial experiments, where the students tried to figure out appropriate conclusions or unknown findings; rather, teachers demonstrated experiments to their students, then asked them to repeat them and follow the same instructions. In other words, in most of the observed experiments, students knew the outcome of the experiments before conducting them. Thus, I doubt that these practical approaches were applied to offer opportunities to the students to experiment with their own ideas and draw new conclusions. Instead, these observed activities were applied to train and prepare the students for practical exams. This point was frequently mentioned by both students and teachers. Although the teachers stated that the suggested practical ideas in the teacher's book comprise great practices to foster creativity, these practical ideas were neglected by the teachers due to several barriers stated in the post-observational interviews, including a lack of time, a lack of materials, and a huge curriculum.

It can be concluded from this section that differences between beliefs and practices are evident in terms of pedagogical approaches for fostering creativity. Although the teachers believed these approaches to be effective for fostering students' creativity, their practices were not necessarily in line with their beliefs. Putting pedagogical beliefs into classroom practices did not appear to be one of the teachers' priorities; rather, science teachers seemed to apply more teacher-centred, traditional teaching and learning approaches than student-centred ones. Even when one of the four approaches was applied, it was insufficiently applied because the teachers put restrictions on students' interactions. For example, scientific dialogue could be seen between teacher and one student, but it was not allowed among two or more students. In addition, teaching thinking skills was not evident in the observed lessons among all the cases despite teachers stating that questioning, reasoning, brainstorming, and problem solving should be used to foster creative endeavours. Experiments and inquiries were restricted as well; the teachers conducted the activities themselves as a scientific show then allowed their students to repeat the show, meaning the scientific inference of the activity was already known to the students before they conducted the experiment or inquiry. Thus, the observed practices are mainly based on transmitting knowledge and giving information.

It is important here to mention the observed practices within extracurricular sessions were dissimilar to teachers' practices within regular science classes, because teachers were more likely able to implement the four approaches within extracurricular activities. For illustration, although supporting thinking skills was not evident in regular science classes, the teachers were encouraging students' questioning, reasoning, problem solving skills within extracurricular sessions, especially the scientific research projects; in which the students posed different questions regarding their projects and addressed their possible solutions. Also, brainstorming and problem solving skills were encouraged within science club sessions, it appeared that science teams used brainstorming sessions to manage their work and put plan for future steps. Moreover, all the observed extracurricular sessions stood on learning-based inquiry as well as experiments. For example, science projects focused on open inquiry, where the students who would conduct a project should construct the empirical research from A-Z under the science teacher's supervision. The students were responsible for managing their project including getting idea, collecting data, outdoor investigations, conducting experiments, analysis and interpreting the data, and creating poster and hardcopy of the project. Furthermore, cooperation among students and with their teacher appeared to be the core of the extracurricular activities (e.g., science research projects, science club, scientific teams, and robot competition). Therefore, it can be concluded that science teachers preform differently within extracurricular sessions, comparing to their practices within regular science classes.

I would argue here that two issues could be used to interpret how the pedagogical beliefs being put into practice in terms of fostering creativity were weak. Firstly, the teachers attributed these differences among their beliefs and practices to multiple contextual barriers and difficulties, which prevented or limited them from putting their beliefs into practice. Difficulties included the absence of facilitating factors and the existing of constraining factors in the Kuwaiti educational context, which in turn influenced teachers' pedagogical decisions. Consequently, teachers could be more likely to make decisions to apply pedagogical choices that confronted fewer contextual difficulties. Secondly, the goal orientation of the educational system in Kuwait could also play an influential role in science teachers' pedagogical decisions. For example, the findings revealed the science teachers' goal orientations are helping students pass school examinations and transmit the science textbook's information; teachers focus on these goals because the Kuwaiti educational system aims to achieve such goals. Consequently, science teachers' pedagogical decisions could be affected by the system's goal orientation, and then teachers would be more likely to make pedagogical choices that reinforce and ensure the achievement of these goals. As such, the goal orientation of the educational system and the contextual barriers of the surrounding contexts create differences between teachers' beliefs and practices.

This conclusion indicates that the teachers' pedagogical decisions are not an individualistic matter, but rather are affected by sociocultural impacts. Hence, the next section discusses the role of these impacts on teachers' beliefs and practices by discussing the findings of the fourth and fifth research questions.

9.5 Teacher's beliefs and practices and the sociocultural influences

The aim of this section is to critically discuss the consistency and inconsistency levels of the belief–practice relationship. It then discusses the emergent role of sociocultural contexts on teachers' beliefs and practices, discussing two facets to draw a clear conclusion about the role of sociocultural contexts. The discussion of the two facets can be used to interpret the different existing levels of consistency and inconsistency within the belief–practice relationship. The first facet is that certain sociocultural factors appear to constrain teachers' beliefs and practices and guide teachers to implement specific practices that may or may not be consistent with their beliefs. The second facet is that there is a mutual interaction between teachers' experiences and the surrounding contexts plays a great role in forming the beliefs and practices of science teachers. For example, beliefs are shaped through interactive and mutual experiences between teachers and their contexts; these beliefs may or may not be transferred into classroom practices.

9.5.1 Consistency and inconsistency levels between teachers' beliefs and practices

When the cut-off point technique was adopted to categorize beliefs and practices according to Cropley's (1997, 2001) criteria, it revealed four groups that illustrate different degrees of consistency or inconsistency between teachers' beliefs and practices. A brief summary of these groups is worth noting here. Only two cases (Jasser and Omar) demonstrated a consistent degree between their beliefs and practices. Jasser held non-creativity-fostering beliefs and applied non-creativity-fostering practices. Meanwhile, Omar held mixed beliefs and applied mixed practices. The remaining cases (Mohammed, Zayed, Fahed, Ali, Khalid, and Salem) manifested inconsistencies compared to what they stated as beliefs in the interviews with their observed practices. For instance, the cases of both Mohammed and Zayed were mainly traditional, because the findings indicated that they held mixed beliefs, but their practices were non-creativity-fostering ones. Furthermore, the other four cases (Fahed, Ali, Khalid, and Salem) held creativity-fostering beliefs, but they applied mixed practices (see Figure 32).

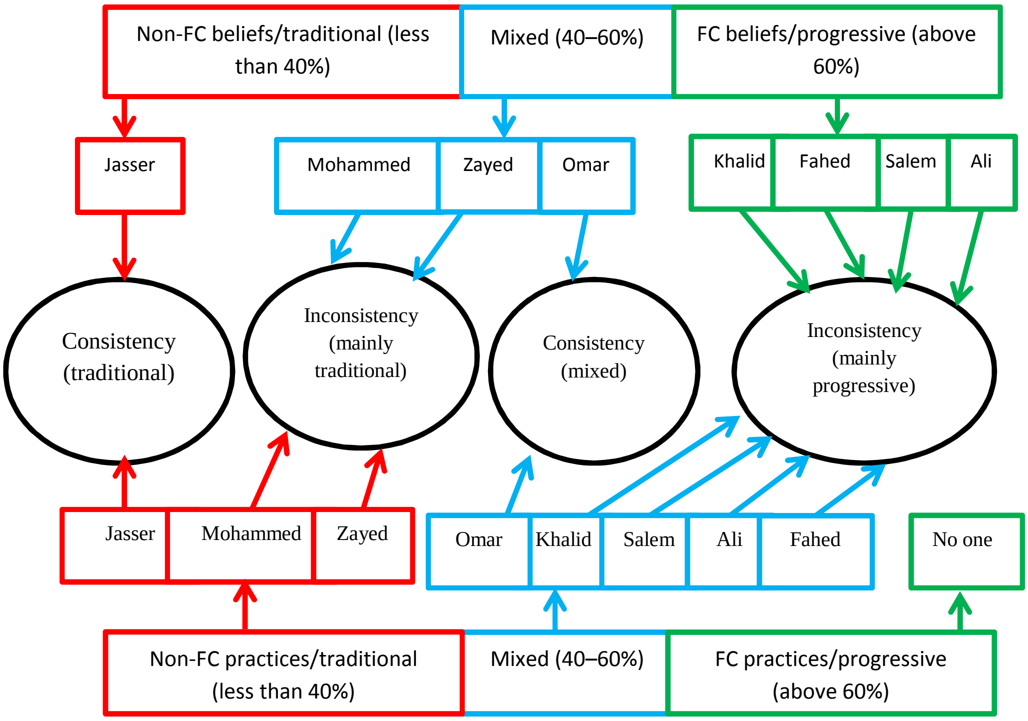


Figure 32: levels of consistencies and inconsistencies between teachers' beliefs and practices

Three key points can be derived from the findings on consistencies and inconsistencies that need to be interpreted and discussed in light of previous work and arguments. Firstly, most of the cases (6 out of 8) showed a degree of inconsistency between beliefs and practices. Secondly, the six inconsistent cases held more progressive beliefs compared to their practices. In other words, teachers' practices for fostering creativity are always one step behind their beliefs. Thirdly, creativity-fostering practices are absent in all cases. To discuss these points, the cases are divided into two sets: consistent and inconsistent sets.

9.5.1.1Consistent cases

The current study found consistency between beliefs and practices in only two cases (Jasser and Omar). Jasser was a traditional case. He held non-creativity-fostering beliefs and applied non-creativity-fostering practices. The observed activities were mainly teacher-centred, as the teacher controlled everything in the class. Jasser was textbook-oriented and focused on transmitting the knowledge and information written in the science textbook. He did not appreciate applying social and interactive activities in classes, which offer students chances to interact, talk, and move around the classroom tables, because he was convinced that these sorts of activities will lead to negative outcomes, such as the emergence of disturbing behaviours, wasted time, the loss of control, and failure to deliver the assigned lessons on time. Jasser believed that it is better to teach creative students in special programmes instead of mainstream classrooms because he believed creative students are able or gifted and should be taught using a special curriculum.

Meanwhile, Omar also showed a degree of consistency, but he held mixed beliefs and mixed practices. He believed that student-centred learning should be applied, especially cooperative learning approaches, but he also emphasized the significant role of teacher-centred approaches. The observed practices were in line with what he stated. For example, he applied group work and teacher–student dialogic activities in different sessions. He also directly delivered knowledge by adopting a lecture style and presentations via an interactive board. Omar believed that the direct transmission of information and being authoritarian solved many problems, such as avoiding any delays in the syllabus plan, preventing misbehaviours, saving time, and handling the lack of lab materials.

Thus, an explanation of the consistent cases is definitely essential. These two cases did not show creativity-fostering beliefs and practices, but rather traditional (Jasser) or mixed (Omar) beliefs and practices. Both beliefs and practices were naïve in terms of fostering creativity in the classrooms. Teachers with naïve beliefs are more likely to be aligned with their practices, creating a consistent degree. According to Bell and Linn (2002), teachers with unsophisticated and naïve beliefs do not confront serious difficulties to transform their beliefs into practice. Moreover, other studies revealed similar findings, in which teachers with traditional and simple beliefs demonstrated a consistent degree between beliefs and practices (e.g., Mansour 2013; Olafson & Schraw, 2006); these studies concur with the findings of the current study.

9.5.1.2Inconsistent cases

Six of the 8 cases showed inconsistency between their beliefs and practices. This finding indicates that putting teachers' beliefs into practice is not a smooth process, especially when teachers hold creativity-fostering beliefs (Khalid, Ali, Fahed, and Salem). Four teachers with creativity-fostering beliefs could not demonstrate creativity-fostering practices; rather, they implemented mixed practices. Meanwhile, Mohammed and Zayed held mixed beliefs, but their practices were traditional.

With respect to previous empirical works, several studies investigated the relationship between teachers' beliefs and practices, concluding that inconsistency between professed beliefs and applied practices are strongly apparent (e.g., Duffy & Anderson, 1984; Levitt, 2001; Mansour, 2013; Mohamed, 2006; Ogan-Bekiroglu & Akkoç, 2009; White, 2000). This suggests that the classroom context is a multifarious one in which teachers' pedagogical beliefs are not the only variable affecting the formation of pedagogical practices. For example, Fang (1996) affirmed that the classroom is a sophisticated context; therefore, teachers' practices are more likely to be dissimilar to what they believe in. Such a sophisticated context might force teachers to partly or completely abandon their beliefs when they prepare classroom practices; as other researchers stated, it is difficult to keep the teachers faithful to their beliefs when they have to interact with complex contexts such as the classroom (Fang, 1996; Mansour 2013).

Bearing in mind the previous point, the findings also revealed the absence of creativity-fostering practices (see Figure 8.2). Within each inconsistent case, the teacher's belief toward fostering creativity outweighed the applied practices. These points infer that contextual factors mediate the relationship between beliefs and practices and that these factors work as constraints that limit the professed beliefs of teachers to be transferred into practices. For that reason, science teachers' pedagogical beliefs were more progressive toward fostering creativity than their practices in all the inconsistent cases of the current study. As evidenced in numerous studies within teachers' beliefs and practices, these mediating factors are considered barriers that form an incongruent situation (e.g., Mansour, 2008, 2013; Mohamed, 2006; Olafson & Schraw, 2006; Schraw & Olafson, 2002; Wilcox-Herzog, 2002).

Within the context of the study (i.e., Kuwait), contextual factors play a greater role in forming teachers' practices compared to the role of teachers' beliefs, through which teachers could not create consistent situations between what they believe in and what they apply on a daily basis. A consistent situation was found within non-creativity-fostering teachers whose beliefs and practices were either both traditional or mixed. Therefore, it could be argued that the current Kuwaiti educational context is not prepared to embrace and encourage creativity-fostering practices within science classrooms because the system's regulations, aims, demands, and resources are seen as constraining contextual factors by science teachers. Therefore, these contextual factors need to be discussed in terms of their influences on teachers' beliefs and practices.

9.5.2 Constraints as mediating factors between teachers' beliefs and practices

As shown thus far, inconsistencies exist between teachers' pedagogical beliefs and their applied practices in most cases. The gap that occurs between beliefs and practices was evident when fostering students' creativity in the science classroom was explored. Such a gap is present because several factors constrain the teachers from conveying their beliefs into practices, as evidenced in studies focused on the relationship between beliefs and practices (e.g., Mansour, 2008, 2013; Mohamed, 2006; Olafson & Schraw, 2006). The current findings indicated that the mediating constraints can be categorized into three categories in which each category has different features: external, personal, and interpersonal constraints.

This categorization concurs with the findings of other research (e.g., Mansour, 2008; Maxion, 1996). Maxion (1996) concluded that external and internal factors mediate teachers' beliefs and practices; meanwhile, Mansour (2008) identified external (physical), internal (personal), and interpersonal factors. The current study agreed with the findings of Mansour's (2008) study, through which these constraints directly or indirectly affect teachers' practices, because a constraint can affect teachers' beliefs and, thereby, affect the classroom practices. For example, a lack of knowledge about creativity and the absence of in-service training courses might lead to traditional beliefs, as in the case of Jasser, who transferred his traditional beliefs into classroom practices.

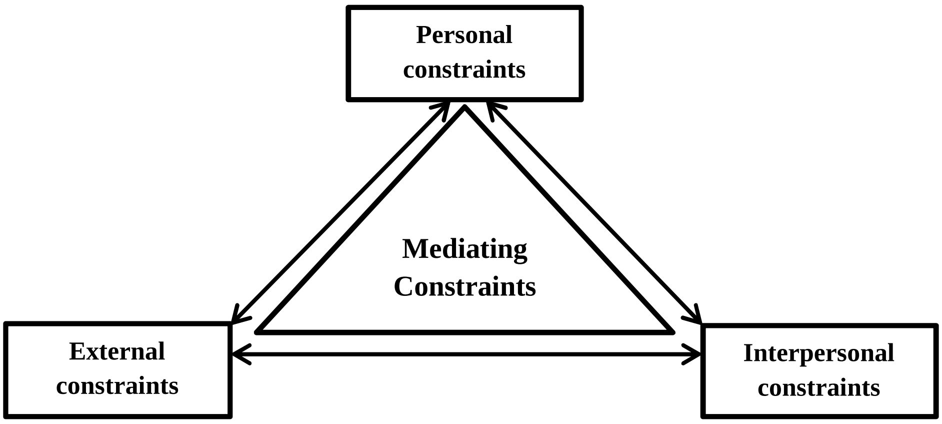


Figure 33: Constraints mediating teachers' beliefs and practices to foster creativity

Therefore, the mediating factors play a major role in shaping teachers’ beliefs and practices and in creating the degrees of consistencies and inconsistencies between these beliefs and practices. It is worth mentioning here that there is a degree of overlap among these mediating factors, as external constraints might generate personal constraints or interpersonal constraints might create personal constraints and so forth.

9.5.2.1 External constraints

Five factors revealed as external constraints relate to organizational and structural issues. The data analysis indicated that these factors are frequently stated together, such as the heavy curriculum, restricted syllabus, lack of time, and lack of resources. These four constraints are commonly pointed out among teachers and collectively mentioned when teachers are asked about the barriers confronted. Research within the creativity domain has shown strong evidence on the existence of multiple contextual factors that prevent teachers from fostering students’ creativity within formal educational settings (e.g., Alkharas, 2013; Felith, 2000; Fryers & Collings, 1991; Hong & Kang, 2010; Johnston, 2009, 2007; Mohammed, 2006). Nearly, all of these studies found that the structured schedule of the syllabus, covering extensive textbook content within limited time and resources, diminishes teachers’ temptation to foster creativity because these factors generate inappropriate context to foster creative learning.

As previously revealed, teachers expressed several facilitating factors related to the educational setting, such as encouraging personal freedom, providing sufficient time, rewarding students, and integrating modern technology within the science classroom. These facilitating factors are discouraged by these external constraints, through which these constraints have contrary effects on teachers' performance toward fostering creativity. The teachers felt that they face pressure to be in line with the structured schedule and teach al of the textbook content without delay. Also, the data from the post-observational interviews showed teachers' justifications for the reasons they applied teacher-centred approaches; interviewees indicated that these mediating constraints force them to focus on the direct transmission of knowledge and prepare students for school examinations. This could explain why transmitted knowledge and passing examinations appeared to be the major goals of science teachers.

Furthermore, teachers revealed another constraint: the absence of a creativity assessment. Four teachers stated that the current assessment criteria do not comprise assessment tools to measure and evaluate creative behaviours. This constraint is in line with the finding of a study conducted in Kuwait (Sayar et al., 2009) that concluded educators highlighted the urgent need to modify the criteria and tools of students' assessment to be harmonized with the requirements of fostering creativity. As previously suggested, science teachers and educational policymakers should rethink their relationship and establish a sort of partnership to overcome such external constraints and ensure external facilitators instead. Teachers should share with educational stakeholders their views and feedback, in which their reflections would refine the external impacts to facilitate the creativity-fostering context.

9.5.2.2 Personal constraints

The data analysis illustrated three personal constraints: being stressed, having a poor knowledge of creativity, and controlling matter. For example, all the teachers felt that they are stressed and overloaded by many tasks. More specifically, the data indicated that teachers are asked to do teaching and administrative tasks; meanwhile, they intensely strive to teach all of the textbook materials on time using the settled science syllabus. In other words, the external constraints generate continuous tension, through which science teachers have to cope with the educational system's demands. As a result, they complained about the work overload, which leads to negative psychological statuses, such as being strained and stressed. This finding agrees with other findings in similar (Alkharas, 2013) and different cultural contexts (Felith, 2000; Fryers & Collings 1991; Mohammed, 2006). Although such problems have been identified by different studies, stressed and overloaded teachers might be more obvious in the Kuwaiti educational system. For example, there is a lack of faculty members and no teaching assistants (Sayar et al., 2009). Also, the schools' management suffers from a lack of employees. So it is common to ask the teachers to do extra office work besides their teaching tasks (Alkharz, 2013).

Possessing a limited or narrow knowledge base of how to foster creativity was identified by four teachers. They revealed that their lack of knowledge is a significant constraint that could promote non-creativity-fostering practices. Teachers admitted that they need to update their knowledge of creativity as well as modern teaching and learning approaches. Similarly, Johnston (2009) confirmed that inexperienced teachers who have a limited knowledge of creativity are used to adopting the direct transmission of information to ensure the delivery of curriculum areas. This constraint raises a question regarding the role of pre-service and in-service training courses and workshops for increasing teachers' knowledge of creativity issues. However, it is noteworthy that training courses appeared to be another constraint identified by the teachers, who emphasized the limited number of training courses, especially those focused on fostering students' creativity.

The final personal constraint is teachers' control. It was obvious that teachers were used to controlling all classroom activities; student-centred activities were avoided so as not to share control with their students. The data analysis showed that teachers simultaneously talked about teachers' control when they talked about disruptive behaviours. Thus, they believed that control is necessary to prevent disturbances inside the classroom. Nevertheless, Mohamed (2006) found that teacher control does not lead to friendly relationships and precludes creative interactions; indeed, it increases the gap between the students and the teacher. He also concluded that interactive activities are omitted and replaced by importing knowledge activities in order to sustain teachers' ability to control the class. Therefore, the finding of the current study seems to concur with the findings of Mohamed's study with respect to teachers' control. Moreover, Murphy et al. (2005) found similar results and stated that teachers premeditate to apply teacher-centred approaches instead of student-centred ones to minimize and control behavioural problems.

9.5.2.3 Interpersonal constraints

Considerable evidence emerged in the current study about the existence of interpersonal effects that impede science teachers' efforts to apply practices for the sake of fostering students' creativity. The findings explicated four interpersonal constraints: disruptive behaviour, parental attitude toward education, lack of training courses, and weak link with experienced institutions.

The interpersonal constraints are related to the previously discussed constraints. For example, teachers' willingness to control the classroom activities was justified by asserting that they are preventing any form of disruptive behaviours. On the other hand, fostering creativity requires interactive classroom activities that support students' dialogues, the sharing of ideas, and group work (Craft et al., 2008; Johnston, 2009; Rietzschel et al., 2009). However, 5 teachers believed that this interactive engagement would encourage "troublemakers" to create problems and misbehave during the activity. This situation could explain why student-centred activities were limited whereas teacher-centred ones were evident in all cases. I would agree here that preventing misbehaviour by controlling students' actions is not an impressive solution; teachers should adopt intervention strategies to modify behavioural problems instead of constraining students' interactions. Therefore, schools' management, especially social workers and psychologists in schools, need to reconsider the contemporary behavioural interventions to be adopted. This might help the teachers rethink the application of more interactive activities.

Another constraint is parental attitude toward education. Five teachers highlighted that parents focus on passing examinations and achieving high grades. In Kuwait, parents' attitudes and expectations are based on numerical outcomes, as they measure the children's learning through the monthly and annual reports. Therefore, teachers criticised that parents' demands are usually associated with teaching students to get higher marks on exams and annual reports; they also revealed that parents neglect other skills that are not subjected to assessment. It is possible that parents' attitudes and demands affect teachers' practices, and the observations revealed that teachers focused on the content of textbooks, especially those areas more likely to be included on exams. Even students across the focus groups highlighted that their teachers focus on possible questions to be included on the exams. As witnessed in Fryers and Collings's (1991) study, parental attitudes and expectations form negative pressure on teachers, through which parents manifest great levels of nervousness associated with their children's performance and success. Consequently, these attitudes constrain teachers in their efforts to foster creativity and promote more students' performance by focusing on what parents expect to see from their children's learning (Fryers & Collings, 1991).

The findings revealed two other interpersonal constraints: a weak link with experienced institutions and the lack of professional training courses. These two constraints could lead to possessing a narrow knowledge base related to fostering creativity in the science classroom. As previously revealed, a narrow and poor knowledge base is one of the personal constraints mentioned by the teachers in the current study. Teachers' knowledge of creativity issues is a very significant factor because such knowledge is an integral part of the process when putting beliefs into practice. There are two arguments: One addresses the knowledge–practice relationship, and the other addresses the knowledge–belief relationship. For instance, Roehler et al. (1988) argued that teachers' knowledge plays great role in forming classroom practices. Other scholars also agreed that there is an affirmative relationship between teachers' beliefs and knowledge (e.g., Kagan, 1992; Mansour, 2008; Nespor, 1987).

Drawing on both arguments, it can be concluded that teachers' lack of knowledge about how to foster creativity prevents teachers' from fostering their students' creativity. Therefore, educational policymakers should offer training courses to increase teachers' knowledge about creative education and help them be adequately prepared for fostering creativity in their classes. Teachers need to gain more knowledge from specialized and experienced trainers because the available training courses are very limited. For example, Abdualwahab et al. (2008) reviewed the in-service training courses prepared by the Ministry of Education in Kuwait and found that there are no courses specialized on creativity and innovation or even courses that teach teachers how to deliver the subject through unusual and original ways to promote students' creativity. However, these courses should not be mandatory; rather, they should be optional. In other words, the ministry needs to vary its training courses to offer opportunities for continuing professional development (CPD) and offer teachers the freedom to enrol in the courses according to their needs and requirements. Such courses would encourage teachers to develop their professional skills and knowledge and sustain their own autonomy by giving them the right to choose the courses they want to attend.

The contextual constraints, including external, personal, and interpersonal constraints, appeared to play a role in creating the degree of consistency and inconsistency between teachers' beliefs and practices. The other influential role of the sociocultural contexts can be seen through the relationship between these contexts and teachers' experiences, in which mutual interactions contribute to forming teachers' beliefs and practices. The next section aims to discuss this influential role.

9.5.3 The relationship of sociocultural contexts with teachers' experience

The case studies' findings revealed that there are multiple intertwined contexts in which science teachers interact, such as classroom, school, science mentorship, academic, personal, and societal contexts. These contexts play a great role in forming teachers' beliefs and practices. Researchers have argued that the sociocultural forces should be explored when teachers' beliefs and practices are under investigation (e.g., Ajzen, 2002; Lederman, 1992; Mansour, 2008, 2009, 2013; Olafson & Schraw, 2006; Schraw & Olafson, 2002; Wilcox-Herzog, 2002). Teachers' beliefs cannot be found in emptiness; rather, beliefs are constructed within contextual boundaries. Thus, the relationship between one's beliefs and surrounding contexts should be explored together (Pajares, 1992).

More specifically, the participants tended to refer to different contexts when they stated, justified, explained, or exemplified their own beliefs. The teachers recalled previous social events with which they interacted as models to support and show evidence about what they believe in. Thus, it could be argued here that the teachers' beliefs are shaped after experiencing social or external interactions with specific contexts. To exemplify this interpretation, I would refer to the teachers' beliefs of student-centred learning. Some teachers referred to their experience with academic contexts to show theoretical evidence of their beliefs (Salem, Mohammed, and Ali); another teacher referred to his previous schooling experience as a student to justify his belief about the teacher-centred learning instead of student-centred learning (Jasser). Meanwhile, Omar, Zayed, and Fahed referred to their experiences as science teachers in the classroom context to illustrate their beliefs. Khalid referred to the societal context where the whole Kuwaiti community believes that student engagement is the centre of the learning process, not the teacher. Therefore, teachers' beliefs are influenced by their previous experiences with contexts. Nevertheless, putting these beliefs into practices has not necessarily occurred due to contextual constraints, as stated earlier in this chapter. Such an influential role of the contexts on teachers' beliefs and practices could be attributed to and understood using the sociocultural theory.

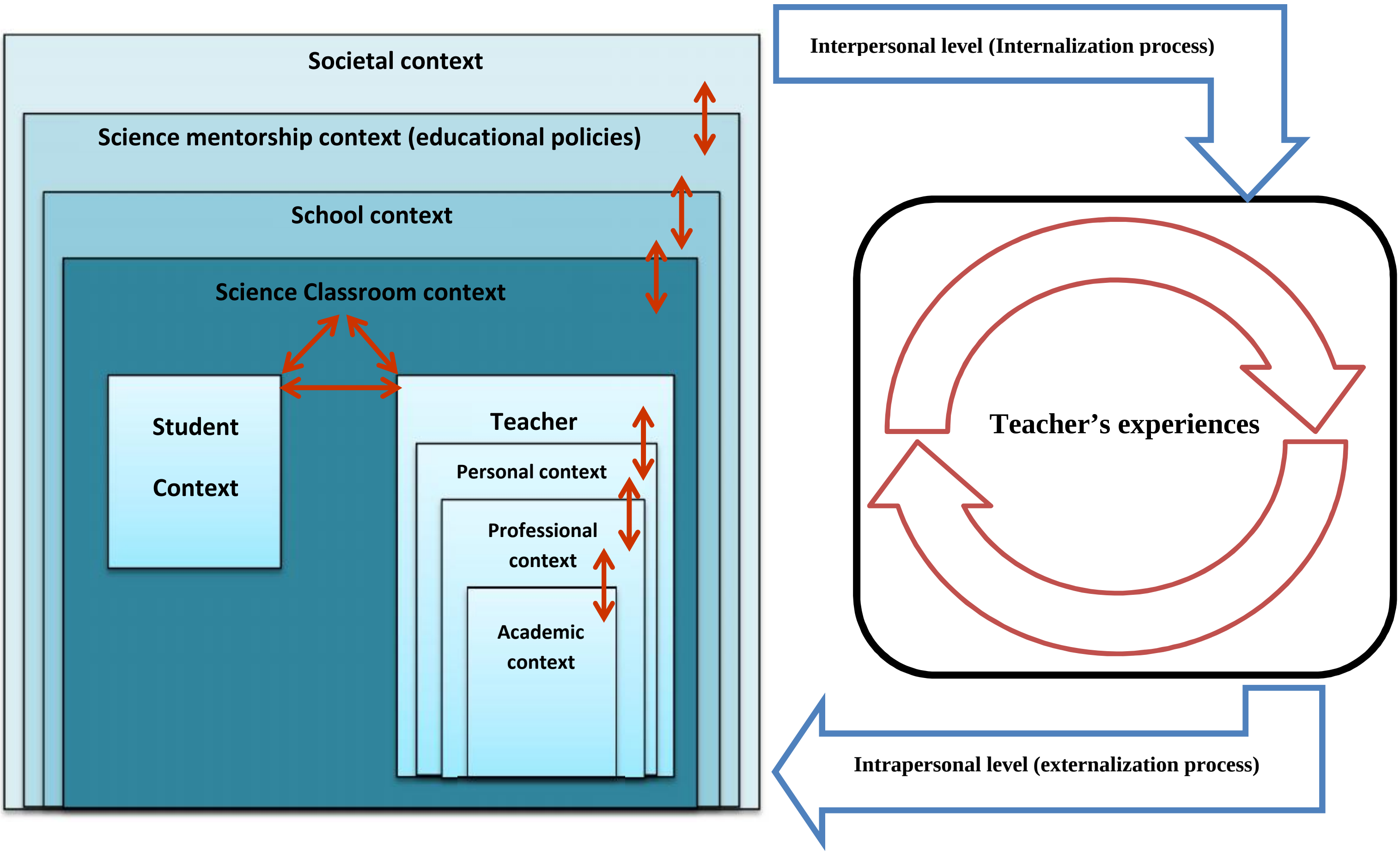
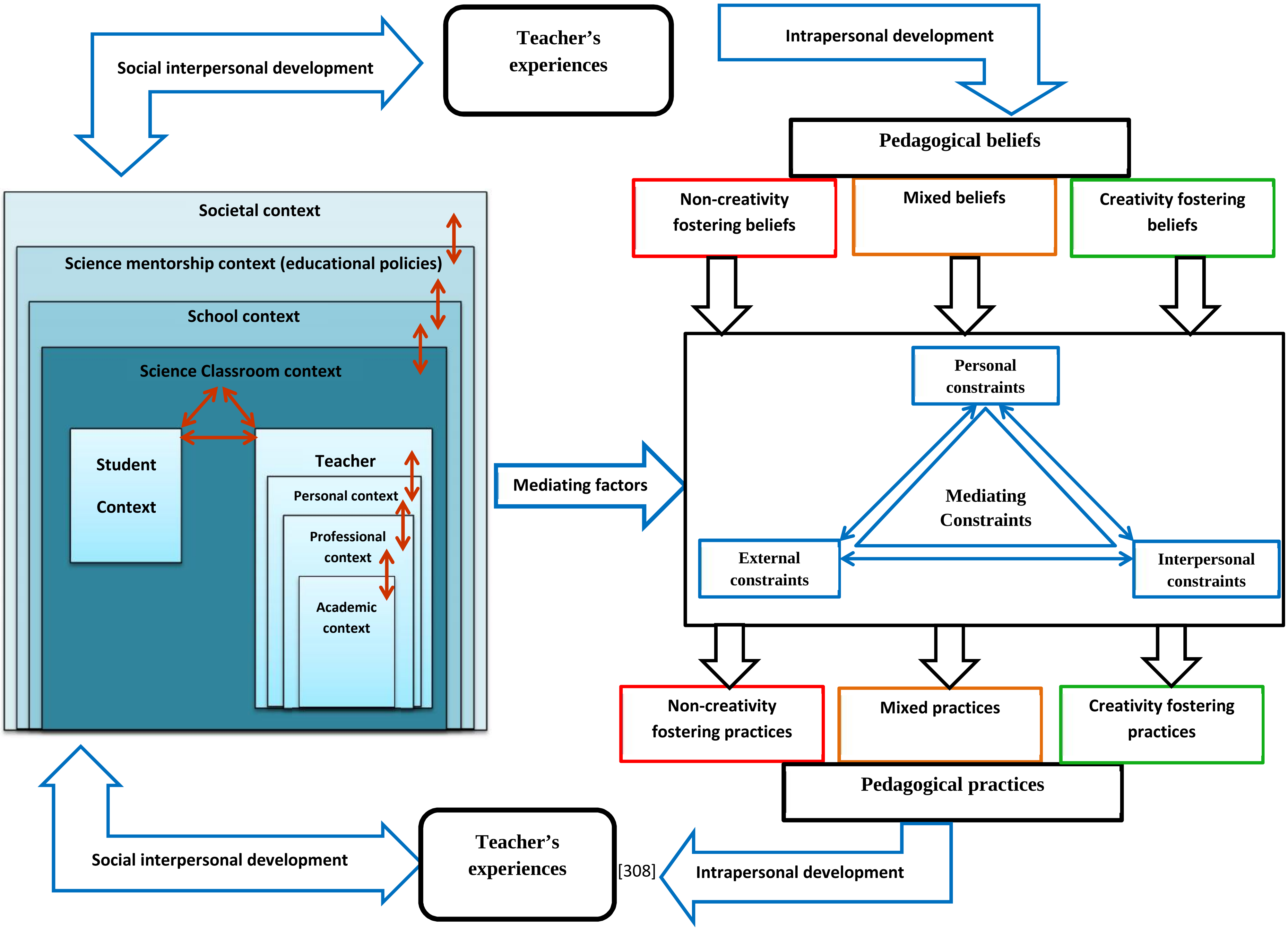


Figure 34: Relationship between teachers' experience and sociocultural contexts

According to the sociocultural perspective, beliefs are cultural artefacts generated from intrapersonal and interpersonal developments. More specifically, these cultural artefacts (e.g., pedagogical beliefs) are based on interacting with external events but not restricted by these events; in other words, the development of beliefs occurs on two levels—namely, social (interpersonal) and individual (intrapersonal) levels. At the social level, the individual (e.g., teacher) interacts with the contextual event through mediating cultural tools leading to a primary experience that is transformed to the individual level (internalization process). Within the individual (intrapersonal) level, the primary experience is reconstructed through a mental process without the need for an external social event. As a result of these two levels of development, individuals can generate new cultural artefacts (e.g., beliefs), which can be used in different social events (externalization process) in order to construct new artefacts and so on (Lantolf, 2000; Lave & Wenger, 1991; Valsiner, 1987; Vygotsky, 1978; Wertsch, 1991, 1994, 2007). Therefore, the sociocultural contexts in which the teachers are situated can develop their experiences and shape their beliefs through cultural and external interactions through the internalization process. On the other hand, teachers' experiences might develop the contexts by putting the new cultural artefacts (beliefs) into new contextual events (e.g., classroom practices) through the externalization process.

9.6 A framework of understanding teachers' beliefs and practices based on sociocultural perspective

Overall, the current study discussed the findings in relation to the existing body of knowledge and interpreted them according to the existence of the body of existing theories. The major affairs related to teacher's beliefs and practices are discussed to understand the relationships between them. These relationships are exemplified by one integrated model that assimilates the previous models in this chapter (see Figure 35).



Social interpersonal development
Teacher's experiences
Intrapersonal development
Pedagogical beliefs
Non-creativity fostering beliefs
Mixed beliefs
Creativity fostering beliefs
Societal context
Science mentorship context (educational policies)
School context
Science Classroom context
Student Context
Teacher
Personal context
Professional context
Academic context
Mediating factors
Personal constraints
Mediating Constraints
External constraints
Interpersonal constraints
Non-creativity fostering practices
Mixed practices
Creativity fostering practices
Pedagogical practices
Social interpersonal development
Teacher's experiences
Intrapersonal development

Figure 35: A framework of understanding teachers' beliefs and practices based on sociocultural perspective

In my attempt to discuss the findings of the first research question, I outlined two approaches to creativity beliefs. Teachers' belief of creativity in terms of it is aspects, elements, models, and potentiality appeared to be a point of consensus among teachers and it concurred with the arguments of creativity scholars. However, this sort of belief seems to be general because it does not address the teachers' beliefs of fostering creativity in the science classroom. Thus, the other approach discussed the teachers' beliefs of fostering creativity in the science classroom; this this discussion, differences were found among teachers. Four teachers believed that creativity is embedded in the science field whereas the other four teachers did not explicitly share similar beliefs. This difference can be related to the teachers' understanding of NoS, through which creativity is NoS (Abd-Elkhalick & Lederman, 2000; Johnston, 2009; Osborne & Dillon, 2008;). Therefore, a lack of understanding NoS could lead to holding naïve beliefs about fostering creativity in the science classroom.

The second question revealed the science teachers' beliefs about the facilitating factors required to foster students' creativity. The factors are varied and can be categorized into three dimensions. There are setting-related factors that teachers claimed are controlled by policymakers and science mentors rather than teachers. These include integrating ICT, encouraging autonomy, offering an appropriate period of time, and motivating teachers and students. According to the teachers' beliefs, these four factors are needed for them and their students. The teachers also related some factors to them, such as diversifying approaches, linking formal with informal science learning, and creating a friendly atmosphere. The last dimension is related to the students' potentiality, such as being curious about scientific topics and being tolerant to uncertainty. Within the context of the study, the teachers indicated that these facilitating factors are absent or weakly apparent because there are interdependent factors that should exist together. For example, the existence of the teacher-related factors is conditional on the existence of the setting-related factors.

On the other hand, the teachers appeared to be more concerned about the existing constraints mediating their beliefs and practices, which become barriers for putting their pedagogical beliefs into practice. As witnessed in the discussion of the third research question, there are differences between the teachers' professed beliefs of pedagogical approaches to foster creativity and their observed practices. The teachers were able to identify pedagogical approaches that would foster creativity inside the science classroom and justify the reasons why they believe in the effectiveness of these approaches to fostering creativity; however, the observed practices were different and also justified by the existing of several contextual constraints. Moreover, the differences between beliefs and practices were evident after adopting the creativity fostering teacher criteria by Cropley (1997, 2001), which resulted in finding four different groups: traditional, mainly traditional, mixed, and mainly creativity fostering groups. The six cases showed inconsistencies between beliefs and practices. Also, creativity-fostering practices were absent in all cases. Therefore, the study argues that the context in which the teachers interact play a significant role in creating these sorts of relationships between beliefs and practices. The sociocultural contexts affect the belief–practice relationship with respect to fostering creativity in the science classroom in two roles.

The first role is associated with barriers divided into three external, personal, and interpersonal constraints. The three types of constraints are interdependent. As Mansour (2008) stated, it is possible that one constraint leads to another one and the absence of one constraint leads to the absence of another one. External constraints are affected by the heavy curriculum, fixed and restricted syllabus plan, lack of time, lack of resources, and absence of creativity assessment. The science teachers felt that they do not have any flexible opportunities to foster their students' creativity; rather, they struggle to meet the curriculum requirements and cope with these restricting external constraints. Therefore, the teachers called for the need to encourage their own autonomy and asked for more freedom with they deal with the science curriculum as a facilitating factor. Moreover, the teachers admitted that there are constraints related to them, such as a lack of knowledge, teacher's control, and negative feelings such as being stressed and overloaded; such personal constraints negatively affect teachers' pedagogical decisions related to adopting creativity-fostering practices. Interpersonal constraints play a similar role, such as disruptive behaviours, parental attitude, poor links with experienced institutions, and a lack of training programmes.

The other influential role is that the contexts shape teachers' beliefs and practices through mutual interaction between the contexts and the teachers' experiences. This sort of relationship is interpreted by the sociocultural perspective according to Vygotsky (1978) and the works of his advocates. According to the sociocultural theory, beliefs are cultural artefacts based on experiencing mutual interactions between the individual and the sounding contexts, such as classroom, school, personal, academic, or societal contexts (externalisation processes); the outcome of such experiences is then processed by high mental functions to reconstruct the beliefs (internalisation processes). These beliefs may or may not be put into practice in the new experience with the outer context (e.g., classroom context). Therefore, the sociocultural contexts in which the science teachers are situated play a major role in forming teachers' beliefs and practices.

Last but not least, the discussion chapter not only interprets the findings according to the existing body of knowledge, but also leads to implications, contributions, limitations, and suggestions. Therefore, the next chapter concludes the study by addressing these issues.

Chapter Ten: Conclusion

The core purpose of this chapter is to conclude the current study by highlighting four ends derived from the research. First, the study's implications are outlined, including implications for different stakeholders, such as science educators, educational policymakers, and science mentors. Second, the chapter concludes the main contributions of the current study to the body of knowledge. The third section highlights the limitations of the study, and then the chapter ends with suggestions for future research in the final section of the chapter.

10.1 Implications of the study

Several implications are derived from the research findings, which can help in creating superior opportunities to foster creativity in the science classroom in Kuwait. These implications are assigned to different agents, through which policymakers, teachers' educators, science mentors, and science teachers need to contribute in manufacturing effective opportunities to foster creativity in the science classroom.

10.1.1 Implications for science teacher education

Several implications can be derived from the current study and could be adopted by science educators within pre-service and in-service training programmes, including the following.

- ***Non-compulsory programmes for Continuing Professional Development (CPD)***

The study revealed science teachers' different needs and requirements to foster students' creativity; as a result, CPD opportunities for science teachers are required. Nevertheless, these opportunities should be optional programmes in which the teacher herself or himself voluntarily enrols to develop specific areas according to her/his needs. The importance of offering optional programmes is attributed to two points. First, the study revealed that teachers believed that the educational system does not support their own autonomy and encourage them to freely make professional decisions; hence, they could perceive compulsory courses as an extra task imposed on them by the educational system. However, if these courses are non-compulsory, enrolment would be determined by the teachers' requirements and needs. Consequently, the teachers may feel that they can freely make decisions regarding CPD courses and what should they do to improve their own professional development. Second, offering an optional list of CPD courses can meet individual differences among science teachers as each teacher can enrol in specific programmes to improve specific professional weaknesses. Meanwhile, imposing compulsory courses is more likely to neglect the various needs among science teachers who enrolled in such courses.

- ***Teaching the nature of science (NoS)***

The study showed that science teachers' beliefs about fostering creativity in the science classroom varied. A number of science teachers held naïve beliefs about creativity and its relation to science, suggesting that science teachers might lack understanding of the NoS aspects that include creativity. Therefore, it is important to educate science teachers about the nature of their subject through both pre-service and in-service courses. Otherwise, the lack of understanding of NoS is more likely to lead to teaching science in a deficient way, as was argued by Abd-Elkhalick and Lederman (2000). Therefore, the current study argues that offering courses focused on fostering creativity in the science classroom are required; however, creativity is one of seven aspects of NoS. Thus, holding a comprehensive of understanding of NoS aspects would enhance not only the opportunity to foster creativity, but also the delivery of science topics inside the classroom.

- ***Offering educational technology training sessions***

All the teachers believed that integrating ICT into the science classroom would open the chance for more creative interactions. However, it was evident that the current ICT devices were used by teachers for the sake of giving lectures and delivering textbook information; as the observations showed that the current use of ICT appears to serve teacher-centred learning instead of student-centred learning. Consequently, teachers' educators need to review the contemporary educational technology services to offer training sessions to science teachers. The training sessions should focus not only on technical issues, but also on how to effectively implement these devices in their lessons to create more interactive and dynamic classrooms.

- ***Reconsidering coping strategies for workplace constraints***

The teachers are very concerned by the constraints within their workplace context; they cope with these constraints by applying practices inconsistent with their beliefs. For example, teachers indicated that teacher-centred learning helps manage some constraints, such as preventing behavioural problems, saving time, and covering textbook content. Consequently, they applied teacher-centred approaches to reduce constraints, although they believed in the significance of applying student-centred ones. Therefore, teacher education can interfere with efforts to enhance teachers' coping strategies by offering workshops and training courses that help science teachers explicitly negotiate and discuss constraints with other teachers and divergently think of new coping strategies to confront these constraints. Accordingly, the teachers could handle the constraints and shrink the gap between their beliefs and practices instead of applying traditional practices that contradict their advanced beliefs.

10.1.2 Implications for educational policymakers

Some implications can be related to policymakers seeking to enhance the educational policies and create appropriate contexts for embracing teachers' concerns and students' creativity. Two issues are addressed here and directed to the policymakers within the Ministry of Education of Kuwait.

- ***Include science teachers in making decisions (partnership)***

The study illustrated that the teachers felt isolated, as their voices were not heard by the educational policymakers. Science teachers considered themselves to be at the bottom of the educational pyramid and their roles are to achieve the goals and implement the regulations established by the educational leaders. This situation is attributed to the centralized system of education in Kuwait, where aims, regulations, and principles are centralized decisions that affect the teachers' careers. Therefore, the teachers' views about these decisions need to be heard by allowing them to provide regular feedback about these decisions. Moreover, policymakers need to create a partnership with the teachers in order to include teachers' perspectives to form new policies and reform old policies.

- ***Minimize external constraints and supply facilitating factors***

The revealed constraints appeared to affect teachers' beliefs and practices. The teachers listed a number of existing constraints that limit their ability to foster creativity in the science classroom, such as a lack of time, a lack of resources, a restricted syllabus, a curriculum-heavy approach, and the absence of creativity assessment. These constraints, in addition to asking science teachers to do administrative tasks, made them feel overloaded and stressed. Furthermore, the teachers pointed out the need for facilitating factors, such as encouraging teachers' autonomy, integrating ICT, and motivation and acknowledgment. Thus, the educational policymakers need to rethink these factors and take into account the teachers' points of views.

10.1.3 Implications for science mentors (curriculum developers)

The Science Mentorship Department also plays great role in teachers' practices in which science mentors guide and assess science teachers' performance as well as give instructions and review the rate of success in science. Thus, some implications can be adopted by science mentors to refine the science learning context and foster creativity more.

It was evident that the teachers' orientations enabled them to deliver the textbook information and help students pass school examinations regardless the teaching and learning approaches used to achieve these goals. Such practices of science teachers correspond with science mentors' goals and guidance. For example, the science mentor assesses teachers' performance according to these two goals, as the teachers declared. First, the science teacher should cover the textbook topics according to the fixed schedule of the Science Mentorship Department. Second, the rate of students' success on exams should exceed 70%; teachers who fail to achieve this rate will be subjected to an administrative investigation to identify the reasons for failing. This approach to assessing teachers' performance reinforces teachers' approaches as exam and textbook oriented, which is more likely to lead to more traditional teaching and learning approaches. Therefore, new ways of evaluating science teachers' professional performance are necessary because the current ones contribute in making teachers more textbook and exam oriented. It is also important to encourage teachers to shift their orientations from delivering textbook information to more interactive learning. Science mentors need to differentiate between the science curriculum and the science textbook, where the textbook is only part of the science curriculum. As science teachers referred to the importance of linking formal with informal science learning, science mentors and teachers have to create various learning opportunities, including indoor and outdoor activities, as part of the science curriculum. Specifically, experienced institutions aim to support creative youth and their endeavours in the science field, such as the Kuwaiti Scientific Club (KSC), Sabah Al Ahmed Centre for Giftedness and Creativity (SACGC), Kuwait Foundation for the Advancement of Sciences (KFAS), and Kuwait Institute for Science Research (KISR). These institutions can contribute to creating open learning opportunities for students who hold creative ideas and can offer experiences with science teachers as well. Therefore, science curriculum developers can embrace the role of outdoor activities and generate connections between learning within school walls with scientific institutions in the Kuwaiti society.

10.2 Contributions of the study

All studies need to contribute to the existing body of knowledge in a specific domain, especially research conducted as a requirement for academic degrees such as PhD studies. According to Petre and Rugg (2004), contribution to knowledge refers to adding something to the discourse, through which it can be seen as “significant—albeit modest—contribution”; such contributions are characterized by answering “so what? questions” (p. 14). Thus, the discussions and interpretations expand to go beyond the findings of the study and draw further suppositions. The aim of this section is to summarize the current study’s contributions.

A) Filling research gaps within the Kuwaiti context

The contextually original research questions aim to fill the research gaps and provide answers to meet the current educational demands with respect to fostering students’ creativity within the Kuwaiti educational system. In the last few years, the Kuwaiti educational system, represented by the Ministry of Education, has funded a number of educational studies focused on fostering creativity (e.g., Abdualwahab, 2008; Sayar et al., 2009; Sayar et al., 2010). These studies implemented surveys to explore teachers’ and mentors’ perspectives and attitudes on different subjects related to fostering creativity; however, these studies indicated the absence of studies that focus on teachers within a specific domain, such as teachers of science. The current study focused on science teachers' beliefs about and practices for fostering creativity to fill this gap and contribute to the understanding of the relationship among beliefs, practices, and sociocultural influences within the Kuwaiti context.

B) Introducing participants' drawing as a method into Kuwaiti context of educational research

Within the Kuwaiti context of educational research, quantitative approaches such as large-scale surveys and experimentations have been widely conducted. However, qualitative research is lacking, especially within studies on creativity in education, which stand on quantitative methods and statistical analyses (e.g., Alagmi, 2002; Alagmi, 2004; Abdualwahab, 2008; Alhassawi, 1998; Ali, 2000; Aljassim, 1994; Hendal, 2007; Sayar et al., 2009; Sayar et al., 2010). Therefore, it can be claimed that the current study reinforces the adoption of multiple qualitative methods for conducting educational research in Kuwait. More specifically, the current study contributes to the Kuwaiti context of educational research by conducting participants' drawing as a data collection technique; as a result, this technique has now been introduced to educational researchers in Kuwait and can be adopted for future research.

C) Integrating students' perspective into science teachers' beliefs-practices studies

During the development of the research framework, the reviewed literature indicated a gap in terms of the research sample. More specifically, teachers' beliefs-practices studies excluded students' perspective (e.g., Duffy & Anderson, 1984; Levitt, 2001; Mohamed, 2006; Ogan-Bekiroglu & Akkoç, 2009; Olafson & Schraw, 2006; Schraw & Olafson, 2002; White, 2000; Wilcox-Herzog, 2002), although teachers expose their practices to their students on a daily basis. Thus, addressing students' perspectives would add to and allow for triangulation of the collected data, instead of remaining dependent only on teachers' data. In particular, the research design of the current study (multiple case studies) can include students' perspectives as part of each case. As a result, students' voices were included through focus group interviews and drawings to investigate the science classroom context from different angles.

D) The relationship between teachers' NoS and their beliefs about creativity

The study revealed that science teachers held different levels of beliefs with respect to how to foster creativity in the science classroom (non-creativity-fostering, mixed, and progressive). Teachers with progressive beliefs viewed creativity as part of science's nature; meanwhile, teachers with traditional and mixed beliefs did not indicate that creativity is embedded in the nature of science. As noted in previous research on science teachers' beliefs, teachers possessed simple and naïve beliefs about how creativity can be fostered in the science classroom (e.g., Aljughaiman & Mowrer-Reynolds, 2005; Bolden, Harries, & Newton, 2010; Newton & Newton, 2008; 2009a; 2009b; 2010). Therefore, this study aimed to contribute to the body of knowledge by creating a theoretical link between the teachers' beliefs of fostering creativity in the science classroom and their understanding of NoS aspects, through which the study argued that teachers with naïve beliefs (non-creativity fostering, mixed) held deficient views of NoS. Thus, the study argued that such a deficient understanding of the NoS aspects, including the creativity aspect, leads to holding simple rather than progressive beliefs.

E) Providing lists of sociocultural constraints and facilitating factors regarding fostering creativity in the science classroom

Although previous research and arguments have illustrated some constraints of fostering creativity (e.g., Ewing & Gibson, 2007; Felith, 2000; Fryers & Collings, 1991; Haring-Smith, 2006; Mohammed, 2006;) as well as facilitating factors (e.g., Claxton & Lucas, 2004; Cremin et al., 2006; Davis & Rimm, 1998; Halpin, 2003; Jeffrey, 2005; Sternberg, 1999), these constraints and facilitating factors were not specified to the science classroom. Rather, these factors were associated with the general schooling environment. Therefore, the current study provided a special list of constraints (see chapter 7: section 7.3) and of facilitating factors (see chapter 6: section 6.3) associated with fostering creativity in the science classroom. Furthermore, the current study adds the interdependent liaison among the factors of each list. More specifically, the findings revealed nine facilitating factors within three categories (setting-related, teacher-related, and student-related); these categories are mutually reliant on each other. Similarly, the findings revealed 12 constraints within three categories (external, personal, interpersonal), which are mutually dependent and affect each other.

F) Understanding the ability of putting beliefs into practice within extracurricular activities

The study found that teachers perform differently in extracurricular sessions (e.g., scientific teams, scientific inquiry projects, robot competition, and science club) in which they were able to put their pedagogical beliefs into practices. For example, pedagogical approaches such as brainstorming, problem solving, cooperative learning, open inquiries, and indoor and outdoor learning are major approaches implemented by teachers within these extracurricular activities. On the other hand, such approaches were poorly implemented in regular science sessions.

Therefore, the study can contribute to the body of knowledge by interpreting this variance within teachers' pedagogical practices to offer rational explanation. The disparity within teachers' practices between regular science sessions and extracurricular sessions is attributed to the sociocultural influences. More specifically, sociocultural constraints do not appear to impede teachers' beliefs and practices within extracurricular sessions; rather, teachers' autonomies are the basis for making pedagogical decisions during the extracurricular activities.

G) Generating consistency and inconsistency levels based on Cropley's criteria

The findings of the current study contribute to the discourse of creativity, as the study revealed different levels of teachers' beliefs-practices relationships related to fostering creativity (see chapter 8: section 8.2). As discussed in Chapters 4 and 8, most previous studies that focused on science teachers' beliefs of creativity did not state the relationship between beliefs in fostering creativity and their practices for fostering creativity. On the contrary, these previous studies were limited to exploring teachers' beliefs through mainly quantitative measurements whereas the extent of transferring these beliefs into practices was omitted (e.g., Hong & Kang, 2010; Kind & Kind, 2007; Lee & Kim, 2005; Liu & Lin, 2014; Newton & Newton, 2008, 2009a, 2009b, 2010; Park et al., 2006).

On the other hand, few studies have addressed the beliefs-practices relationship, such Lasky's (2012) study, which aimed to document the little "c" of creativity in the science classroom through five high school teachers in the United States. Nevertheless, the current study implemented a different approach to explore the consistencies and inconsistencies between teachers' beliefs and practices by adopting Cropley's (1997, 2001) Creativity-Fostering Teacher Aspects as the criteria for comparing beliefs and practices. As a result, the current study instead addressed the relationship of teachers' beliefs in and practices for fostering creativity within the science classroom and generated the levels of consistencies and inconsistencies among science teachers.

(H) Generating framework of understanding teachers' beliefs and practices based on sociocultural perspective

The current study aimed to provide answers for five research questions to contextually understand belief-practice relationships of science teachers in regard to fostering students' creativity. As a result, the study concluded an integrated model of the belief-practice relationships and the influences of surrounding sociocultural contexts (see Chapter 9: Figure 35). The suggested model contributes in offering an overall interpretation about the complexity of the belief-practice relationship in regard to fostering creativity in science classroom; such model can suggest further implications for educators, policymakers, teachers in Kuwait to support creativity in science classroom. It also helps other audience from similar contexts to transfer this model of understanding to their own contexts such as Arab countries, and specially the GCC countries that stand on similar cultures and backgrounds.

10.3 Limitations of the study

No study exists without difficulties and limitations. Making decisions is the constitutional skill of all researchers, but these decisions could intentionally or unintentionally omit issues that might add more to their investigations. Therefore, the acknowledgment of limitations and difficulties is essential to enlighten other researchers about these limitations. In this section, several issues with the current study are recognized and discussed.

One of the difficulties of this study related to female schools' accessibility. The study focused only on eight male cases (in four male schools) in Kuwait. Although the Ministry of Education could grant me access to female schools to collect data, such consent is conditioned by getting accessibility consent not only from participants, but also from all the staff and students in the female school in order to ensure that such access would not restrict the personal freedom of any member of the staff or students. Thus, as a male researcher, it is hard to access female schools and spend a long time collecting data due to cultural customs. To satisfy such customs, I need consent forms not only from participants, but also from all teachers as well as all students and their parents. This would be extremely difficult and require a lot of time. Another possible solution is to ask a female colleague to collect data from female schools. However, the purpose of the study is academic, in that it is a requirement for obtaining an academic degree. Consequently, asking other person to collect the data would be questionable. Thus, I have excluded female cases in the study because of the hardship of accessing female schools.

Another limitation is associated with the hardship of exploring previous studies that investigate fostering creativity in Kuwait. It was difficult to electronically find studies published in Arabic journals related to fostering creativity in Kuwaiti schools. Therefore, I had to personally visit libraries of different Kuwaiti organizations to review local studies such as the University of Kuwait, Basic Education College, Arabic Center for Educational Research of Gulf Countries, Arab Open University, and Educational Research Sector at the Ministry of Education. These visits consumed a lot of time and efforts; consequently, I had to extend the fieldwork trip from four months to five months in order to review more local studies while collecting the data. This process was also repeated before submitting the thesis to update the current study with the latest studies conducted in the Kuwaiti context.

Furthermore, the findings of the current study are not appropriate for generalization. Although scholars of multiple case studies research have argued that the findings of case studies can be generalizable and suggested different numbers of cases for generalizing findings (e.g., Eisenhardt, 1989, Eisenhardt & Graebner, 2007; Yin, 1994, 2009), the current study does not attempt to generalize the results. For example, Yin (2009) suggested that the researcher should conduct at least six cases for generalizing the research outcomes; meanwhile, Eisenhardt & Graebner (2007) recommended that researchers who aim to generalize findings need to conduct four to 10 cases. Nevertheless, I think that these suggestions represent the personal perspective of Yin and Eisenhardt without providing considerable evidence of the effectiveness of the recommended numbers on generalizability. On the contrary, this study supports transferability instead of generalizability, as discussed in the methodology chapter.

These difficulties should be considered by the readers when they interpret the findings of the current research. And previously stated, all studies have limitations, but these limitations do not conceal the contributions of these studies; rather, addressing these limitations suggest new questions and points for further investigations. Thus, the following section suggests several areas for research in the future.

10.4 Suggestions for future research

Further visions generated from the current study offer prospective grounds of research within the current area of focus. Future research can build on the conclusions of the study to investigate the unanswered questions in this research. Here, some directions are recommended for future research.

First, the current study attributed holding naïve beliefs about fostering creativity in the science classroom to the lack of teachers' understanding of the NoS. This raises several questions, such as: To what extent does the understanding of NoS affect science teachers' beliefs of and practices in fostering creativity? Does teaching science teachers about NoS aspects enhance their beliefs toward fostering creativity? Such questions are highly recommended for further investigations in order to define the role of NoS in teachers' beliefs and practices.

Second, the current study's findings showed that specific individuals interact with science teachers on a regular basis, such as educational policymakers, school principal, science mentors, students, and their parents. Teachers' interactions with these individuals appeared to play a role in forming their pedagogical decisions. Thus, future research of a similar focus needs to include these individuals' perspectives and roles.

Third, the current study found different contexts with which the science teacher interacts, such as the classroom, school, and science mentorship in an academic, personal, and societal context. These contexts mutually interact with teachers' experience, which in turn contributes to shaping teachers' beliefs and practices. A question arises here: What is the most influential context among these surrounding contexts on teachers' beliefs and practices? Future research can draw comparisons among these contexts in terms of their influence on science teachers.

Fourth, the mutual interactions between teachers' experience and the contexts construct teachers' beliefs based on the sociocultural perspective, which implies a continuing change on teachers' beliefs over time, as long as this mutual interaction continues. Thus, a longitudinal study is needed to examine the changes on teachers' beliefs and practices over a long period of time.

Fifth, the findings of the study revealed that science teachers believed in the facilitating role of linking formal with informal science learning and encouraging students' creative endeavours. Nevertheless, no clear empirical evidence was gathered to support such a belief. Thus, questions for further research could be: How does informal science learning encourage students to preform creatively within formal science learning? To what extent does linking formal with informal science foster students' creative performance?

Sixth, all the teachers believed that integrating ICT into the science classroom facilitated creative learning approaches. However, their practices showed that ICT devices such as interactive screens, laptops, smart phones, and overhead projectors were used for teachers' presentations and appeared to support teacher-centred learning. Thus, further research should be conducted on how to promote student-centred learning through the integration of ICT within the science classroom. Such an investigation could provide practical strategies to integrate ICT effectively and creatively.

Finally, it was evident that there is a serious lack of qualitative research being adopted within the Kuwaiti context of educational research. This study reinforced the need to adopt qualitative research in the Kuwaiti educational research context by implementing multiple qualitative methods. Future studies within the Kuwaiti context should adopt qualitative research and explore the rich data from it, rather than being limited to using statistical measurements and analyses.

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Appendices

Appendix A:

Semi-structured interview protocol and questions

"Pre-observation interview"

(English & Arabic copies)

Semi-structured Interview schedule (Pre-observation stage)

The interview protocol
• **Time and date of interview:** the interview will be conducted in the appropriate time that suits the teacher timetable. • **Place:** the place should be suitable in which there is no disturbance and should be secure to maintain confidentiality. • **Audio recording and estimated time:** taking the interviewee agreement about recording the conversation and recording the interview information such as time, date, estimated time for the interview, place, interviewee rights, and the focus area. • **Interviewee's rights and consent form:** remaining the interviewee about his/her rights and submitting the consent form and ensure that interviewee sign before the interview conduction. • **Topic of Focus :** brief description of the research focus and aims

Part (1) ice breaking questions

1- *How many years have you been teaching science in this school?*
2- *Have you taught in any other schools?*
3- *Why did you choose to be a science teacher?*
4- *What kinds of education classes have you taken so far?*

Part (2) teacher's beliefs about fostering creativity in school science

1- *When you hear the word "creativity" what comes into your mind?*
2- *Do you think creativity differs from field to another, in other words, do creativity has different meaning in science than other subjects? How?*
3- *What are the indicators of being creative students in science education?*
4- *Please describe an example of creativity in science manifested by one of your students?*
5- *What are the teaching strategies that could foster students' creativity in your science classes?*
6- *What are the core pedagogical aspects that facilitate fostering students' creativity?*
7- *What do science teacher need to do to foster creativity in the science classrooms?*

Part (3) teacher's practices and activities inside classroom for creativity

1- *What are the aspects that are taken into account when you planning your class activities?*
2- *Can you tell me about, your preferable instructional approach or style? Why do you prefer it more than other approaches?*
3- *How can you stimulate the students' creativity in your activities?*
4- *Could you please give examples of activities that you have implemented in the effort to promote students' creativity?*
5- *To what extent does the current curriculum aim to manifest the students' creativity?*
6- *What are the influential factors that delimit the creative activities in science classes?*

Part (4) sociocultural sources regarding science teacher practices and beliefs

1- *Do you think that teachers need to be trained to foster students' creativity? Why?*
2- *What are the roles of related societal agencies on your pedagogical practices for fostering students' creativity?*
3- *To what extent do the educational policies facilitate fostering students' creativity? Why?*
4- *How do you see the role of both school administration and mentorship with respect fostering students' creative skills?*
5- *If there is something needs to be change in order to promote the students' creativity, what would that be?*
6- *Would you like to add something regarding creativity in general, or promoting creativity in science classroom?*

Thank you very much for your time and kindness

أسئلة المقابلة للمعلم

بروتوكول المقابلة الشخصية
التاريخ والزمن: تحديد الوقت والزمن المناسب بحيث لا يتعارض مع جدول المعلم **المكان:** تحديد المكان المناسب لجراء المقابلة حيث يتسم بالهدوء والخصوصية **الموافقة على التسجيل الصوتي:** أخذ موافقة من المشارك بالتسجيل الصوتي وتوضيح الهدف منه **حقوق المشارك:** تذكير المشارك بحقوقه المذكورة في كتاب الموافقة بالمشاركة **موضوع المقابلة:** وصف ملخص عن موضوع البحث والعناوين الرئيسة للمقابلة

الجزء الأول: الأسئلة الاستفتاحية:

1. كم عددسنوات التي عملت بها كمعلم لمادة العلوم في هذه المدرسة؟
2. هل سبق وان مارست مهنه التدريس في مدرسة أخرى؟
3. لماذا أخترت ان تكون معلم لمادة العلوم؟
4. ما هي المؤهلات التربوية والدورات التدريبية التي اجتزتها حتى هذه اللحظة؟

الجزء الثاني: معتقدات المعلم حول رعاية القدرات الإبداعية في مادة العلوم:

1. عندما تسمع كلمة الأبداع، ما الذي يخطر في بالك؟
2. هل تعتقد أن مفهوم الأبداع في مادة العلوم يختلف عن مفهوم الأبداع في المواد الأخرى؟ لماذا؟
3. ما هي العلامات مميزة للطالب المبدع في مادة العلوم؟
4. من فضلك، اذكر مثل عن الأبداع في مادة العلوم متمثل بنشاط أحد طلابك؟
5. ما هي الاستراتيجيات التعليمية التي تنمي الأبداع العلمي عند الطلبة؟
6. ماهي المكونات الأساسية التي يجب ان تتوافر في طريقة التدريس حتى يتم رعاية الإبداع العلمي؟
7. ماذا يحتاج المعلم حتى يرعى الأبداع الطلابي في مادة العلوم؟

الجزء الثالث: تطبيقات وأنشطة المعلم داخل الفصل الدراسي:

1. ماهي النقاط الأساسية التي تركز عليها أثناء تحضيرك للأنشطة الصفية؟
2. ما هي الاهداف التعليمية التي تركز عليها اثناء تحضيرك للأنشطة وعرضك للدرس؟
3. ما هو الاساليب او الطرق التعليمية التي تميل الى استخدامها أكثر من غيرها لماذا؟
4. كيف تحفز طلابك على ان يكونوا مبدعين في الأنشطة العلمية؟
5. هل من الممكن تزويدنا بمثال عن أنشطة قمت بها لتدعم أبداع الطلاب في مادتك؟
6. الى أي مدى يساهم المنهج الحالي في أظهار ابداعات الطلاب؟
7. ما هي العوامل التي تحد من الانشطة الابداعية في مادة العلوم؟

الجزء الرابع: أثر السياق الاجتماعي والثقافي على قناعات وتطبيقات المعلم:

1. هل تعتقد أن المعلم يحتاج الي تدريب حتى يكون مؤهل لرعاية قدرات طلابه الابداعية؟ لماذا؟
2. الى اي مدى تساهم السياسات التربوية الحالية في رعاية الابداع في مادة العلوم؟ لماذا؟
3. ماهو دور مؤسسات المجتمع ذات الصلة بالمجال العلمي في تطوير طرق التدريس لك كمعلم لمادة العلوم حتى تنمي القدرات الإبداعية؟
4. كيف تقيم دور الإدارة المدرسية والتوجيه الفني حول تنمية القدرات الابداعية عند الطلاب؟
5. إذا كان هناك أشياء تحتاج الى تغيير حتى يمكن رعاية الابداع عند الطلاب ماهي الأمور التي تحتاج الى تغيير او تعديل من وجهة نظرك؟
6. هل لديك أي معلومات أو تعليقات اضافية تود تزويدنا بها حول الابداع في مادة العلوم؟

شكرا جزيلا لتعاونك ومشاركتك في الإجابة على الأسئلة

Appendix B:

Nonparticipant Observation

(Observation sheets)

Case name: …… **Observation number: ……** **Duration: 40 - 45 minutes**

Time: ……… **Class size: ……** **Grade: ……** **copy of lesson plan : yes - no**

Description of the lesson:
………
………
………
………

What are the educational aids and equipment used during the lesson?
………
………
………

Time	Observations	Notes	Coding
	… …………………………………………………………………………… …………………………………………………………………………… …………………………………………………………………………… …………………………………………………………………………… …………………………………………………………………………… …………………………………………………………………………… …………………………………………………………………………… …………………………………………………………………………… …………………………………………………………………………… …………………………………………………………………………… …………………………………………………………………………… ……………………………………………………………………………		

Time	Observations	Notes	Coding
	…………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… …………………………………………………………………… ……………………………………………………………………		

questions for Post-observations interview:

………

………

………

………

………

………

………

Appendix C:

Focus group schedule

(English & Arabic copies)

Focus group schedule

The interview protocol
• **Time and date of interview:** the interview will be conducted in the appropriate time that suits the students' timetable. • **Place:** the place should be suitable in which there is no disturbance and should be secure to maintain confidentiality. • **Audio recording and estimated time:** taking the interviewees agreement about recording the conversation and recording the interview information such as time, date, estimated time for the interview, place, interviewees' rights, and the focus area. • **Interviewee's rights and consent form:** remaining the interviewees about his/her rights and submitting the consent form and ensure that interviewee sign before the interview conduction. • **Topic of Focus :** brief description of the research focus and aims

- ***Students' beliefs about creativity***

  1- What does creativity mean to you?

  2- Who are the creative students?

  3- Do you feel you are creative in science? How?

- ***Students' perception of science classes and teacher practices***

  4- What sort of activities does your science teacher ask you to do?

  5- Do you think these activities help you to be creative in science?

  6- Can you give me example of creative activities offered by your science teacher?

  7- Does your teacher encourage you to be creative in science? how?

- ***Difficulties to be creative in science***

  8- What sort of things that prevent you from being creative in science?

  9- Can you give me some examples that show these difficulties?

- ***Requirements to be creative in science***

  10- What are the possible solutions for these problems, in your point of view?

  11- What do you need from your science teacher or school in order to be creative in science?

Thank you for your time

المقابلة الجماعية

بروتوكول المقابلة
التاريخ والزمن: تحديد الوقت والزمن المناسب بحيث لا يتعارض مع جدول المعلم **المكان:** تحديد المكان المناسب لجراء المقابلة حيث يتسم بالهدوء والخصوصية **الموافقة على التسجيل الصوتي:** أخذ موافقة من المشارك بالتسجيل الصوتي وتوضيح الهدف منه **حقوق المشارك:** تذكير المشارك بحقوقه المذكورة في كتاب الموافقة بالمشاركة **موضوع المقابلة:** وصف ملخص عن موضوع البحث والعناوين الرئيسة للمقابلة

- **مفهوم الابداع عند الطلاب:**

1. ما المقصود بالإبداع؟
2. من هو الطالب المبدع؟
3. هل تشعر أنك مبدع في ماده العلوم؟ كيف؟

- **رأي الطلاب حول الأنشطة الصفية لمادة العلوم:**

4. ماهي الأنشطة التي يطلبها معلم العلوم ان تفعلوها؟
5. كيف تساعدك هذه الانشطة على ان تكون مبدع في مادة العلوم؟
6. هل يمكنك ذكر مثال لأنشطة ساعدتكم على ان تكونوا مبدعين؟
7. كيف يشجعكم معلم العلوم على ان تكونوا مبدعين؟

- **صعوبات تحد من أبداعك في مادة العلوم:**

8. ماهي المشاكل التي تمنعك من ان تكون مبدع في العلوم؟
9. أذكر مثال عن أحد هذه المشكلات؟

- **احتياجات تساعدك على الابداع في العلوم:**

10. حسب اعتقادك ماهي الحلول لهذه المشكلات؟
11. ماذا تحتاج من معلم العلوم او المدرسة أن تفعل حتى تكون أكثر ابداعا في مادة العلوم؟

شكرا جزيلا لتعاونكم ومشاركتكم في الإجابة على الأسئلة

Appendix D:

Ethical Form 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: Hamed Alsahou

Your student no: 590003975

Return address for this certificate: 22 Greyfrairs Road, Exeter, UK, EX4 7BS

Degree/Programme of Study: PhD

Project Supervisor(s): Prof. Anna Craft and Dr. Nasser Mansour

Your email address: ha253@exeter.ac.uk or hamed_alsahou@hotmail.com

Tel: 07799383856

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:........hamed...date:...18\10\2012

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.*

Another ethical dimension in the study is associated with participants' responsibility on the subject of disclosure. BERA (2011) encourages the process of informing participants of the research outcomes after the end of the study. Thus, the research will ask participants to provide electronic mail addresses if they wanted to receive the results.

Secure storage

According to BERA (2011), researcher should protect the data and save it in secure place. The collected data will be securely and anonymised stored, analysed and published. Any indicators of personal information and school names will be removed from all transcribed materials. Ensuring privacy will be taken into account during the process of data collection, data analysis, and findings presentation. Recoded materials, photos, and drawings will be kept in secure storage.

Give details of any exceptional factors, which may raise ethical issues (e.g. potential political or ideological conflicts which may pose danger or harm to participants):

***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: November 2012 **until:** June 2013

By (above mentioned supervisor's signature): .... **date:** 18 / 10 / 2012

***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/12/13/3

Signed: .... **date:** 9/11/12

Chair of the School's Ethics Committee

This form is available from: http://education.exeter.ac.uk/students/

Appendix E:

Accessibility Approval and letters

UNIVERSITY OF EXETER

GRADUATE SCHOOL
OF EDUCATION

St Luke's Campus
Heavitree Road
Exeter
EX1 2LU

Telephone +44 (0)1392 724892
Fax +44 (0)1392 724922
Email education@exeter.ac.uk
Web www.exeter.ac.uk/education

1 November 2012

TO WHOM IT MAY CONCERN: HAMED ALSAHOU

I am writing with respect to Hamed Alsahou, full-time PhD student at the University of Exeter and currently at the start of the third year of four years of study in total. I am Hamed's lead doctoral study supervisor.

Hamed's study focuses on science teachers in Kuwait and he is now ready to undertake his main data collection. This will mean him spending several months in Kuwait, from 1st of December 2012 until 1st of March 2013.

He has my permission to undertake this visit, and I trust this is acceptable to the Kuwaiti authorities also.

Yours sincerely

UNIVERSITY OF EXETER
Graduate School
of Education

Anna Craft

Professor of Education

Kuwaiti Embassy Cultural Office, London
60a, Knightsbridge
LONDON SW1 7JX

Embassy of the State of Kuwait
Cultural Office
London

ســـفارة دولـــة الكـــويت
المكتب الثقافي
لنـــدن

2012/11/05
س ب/أ ك/GPA318

الأخ/ حامد جاسم السهو المحترم
المبعوث من قبل الهيئة العامة للتعليم التطبيقي والتدريب

تحية طيبة، وبعد:

إشارة إلى خطابك الوارد إلينا بالبريد الإلكتروني في 2012/11/04 المتضمن طلبك الموافقة على القيام برحلة علمية إلى الكويت، وكذلك خطاب مشرفك الدراسي المؤرخ في 2012/11/01 المتضمن توصيته على قيامك بهذه الرحلة لأهميتها لمجال دراستك، وذلك خلال الفترة من 2012/12/01 ولغاية 2013/02/28، نود إفادتك بموافقة المكتب على ذهابك للرحلة المذكورة.

نأمل الإحاطة، وتزويدنا بتقرير مفصل عن الرحلة العلمية بعد عودتك، مع رجائنا بعدم التردد في الاتصال بالمكتب الثقافي إذا كانت هناك أية خدمة أو مساعدة يمكن أن نقدمها لك فيما يتعلق بأمورك الدراسية.

مع تمنياتنا لك بالتوفيق.

سيف بشير
رئيس قسم الدراسات العليا

This letter illustrates that the Kuwaiti cultural office has accepted the request for conducting fieldtrip in Kuwait to undertake the main data collection.

60A Knightsbridge, London SW1X 7JX
Please quote our reference
Telephone: 020-7761 8500 Fax: 020-7761 8505
www.kuwaitculturaluk.com

THE PUBLIC AUTHORITY
FOR APPLIED EDUCATION & TRAINING

الهيئة العامة
للتعليم التطبيقي والتدريب

1962 - 2012

الإشارة :

التاريخ : ١٩ يونيو ٢٠١٢

شهادة لمن يهمه الأمر

تشهد الهيئة العامة للتعليم التطبيقي والتدريب بأن السيد / حامد جاسم محمد السهو موفد في بعثة دراسية للحصول على درجتي الماجستير والدكتوراه في تخصص تربية خاصة / تفوق عقلي من جامعة Exeter بالمملكة المتحدة اعتباراً من ٢٠٠٩/١٠/٥ 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.

State of Kuwait

ع / المدير العام

الصفاة (13092) الكويت بدالة: (1806611) فاكس: 22528915

P.O. Box 23167 - Safat (13092) Kuwait - Tel.: 1806611

This is a support letter issued by my scholarship sponsor (the Public Authority for Applied Education and Training) and sent to the Ministry of Education to obtain an access permission and enter governmental schools.

This letter is issued by the Educational Research and Curricula sector

It provides brief information about the research focus and data collection methods. This letter indicates that the research topic and tools are appropriate for conduction in the governmental schools. This letter is sent to the educational provinces.

MINISTRY OF EDUCATION
Educational Research and
Curricula Sector
EDUCATIONAL RESEARCH & DEVELOPMENT ADMINISTRATION

وزارة التربية
قطاع البحوث التربوية والمناهج
إدارة البحوث والتطوير التربوي

التاريخ / / 14هـ

الرقم : وت / ٨٦٨
مرفقات /

السيد المحترم/أ. عبدالله هلال الحربي

مدير عام منطقة حولي التعليمية

تحية طيبة وبعد،،،

الموضوع/ تسهيل مهمة

يقوم الطالب/ حامد جاسم السهو المسجل على درجة الدكتوراه في جامعة اكستر في المملكة البريطانية المتحدة بإعداد أطروحة بعنوان " SCIENE TEACHERS pedagogical beliefs and practices that foster students creativity in Middle "schools in Kuwait: Sociocultural Study"

فيرجى تسهيل مهمة المذكور أعلاه لتطبيق أدوات البحث التالية :

- مقابلات لمعلمي العلوم والطلبة
- تطبيق الخريطة الذهنية على معلمي العلوم والطلبة
- متابعة الأعمال اليومية للطلبة في مادة العلوم

وذلك على عينه من معلمي مادة العلوم وطلاب المرحلة المتوسطة التابعة لمنطقتكم التعليمية خلال الفصل الدراسي الحالي 2013/2012 .

مع خالص الشكر والتقدير

مدير إدارة البحوث والتطوير التربوي
د/ سميرة محمد عبدالوهاب

وزارة التربية
إدارة البحوث والتطوير التربوي

ص . ب : ١٦٢٢٢ القادسية – ٣٥٨٥٣ الكويت – تلفون : ٤٨٣٨٣٢١ - ٤٨٤٢٤٠٤ - فاكس : ٤٨٣٧٩٠٩ - ٤٨٤٢٤٠٤
P.O.Box :16222 - QADSIAH - 35853- KUWAIT- Tel. : 4842404 - 4838321 - Fax : 4837909 - 4842404

State of Kuwait دولة الكويت

وزارة التربية

MINISTRY OF EDUCATION

Ref. : المرجع 008661

Date : التاريخ ٢ - ديسمبر ٢٠١٢

This is a special leaflet issued by the general manager of an educational province to be distributed and sent to intermediate schools. It informs the schools about the fieldwork for the current research, and it shows the ministry agreement of conducting the research in public schools.

نشرة خاصة

للمرحلة المتوسطة / بنين

السادة الأفاضل / مديري المدارس المحترمين

تحية طيبة وبعد ...

الموضوع : تسهيل مهمة

يقوم الطالب / حامد جاسم السهو المسجل على درجة الدكتوراه في جامعة اكستر في المملكة البريطانية المتحدة بإعداد أطروحة بعنوان: "science teachers pedagogical beliefs and practices that foster students creativity in Middle school in Kuwait :sociocultural study".

فيرجى تسهيل مهمة المذكور أعلاه لتطبيق أدوات البحث التالية :

- مقابلات لمعلمي العلوم والطلبة .
- تطبيق الخريطة الذهنية على معلمي العلوم والطلبة .
- متابعة الأعمال اليومية للطلبة في مادة العلوم .
- على عينة من معلمي مادة العلوم وطلاب المرحلة المتوسطة خلال الفصل الدراسي الحالي ٢٠١٢/٢٠١٣ .

وتفضلوا بقبول فائق التقدير والاحترام...

مدير عام منطقة مبارك الكبير التعليمية

وزارة التربية

الإدارة العامة لمنطقة مبارك الكبير التعليمية

مكتب المدير العام

نسخة لكل من :

- إدارة الشؤون التعليمية
- مراقبة التعليم المتوسط
- Hm29/11/2012

ص.ب : ٧ الصفاة - الرمز البريدي ١٣٠٠١ الكويت P.O Box 7 Safat - Code 13001 Kuwait

Appendix F:

Timetable of the main data collection

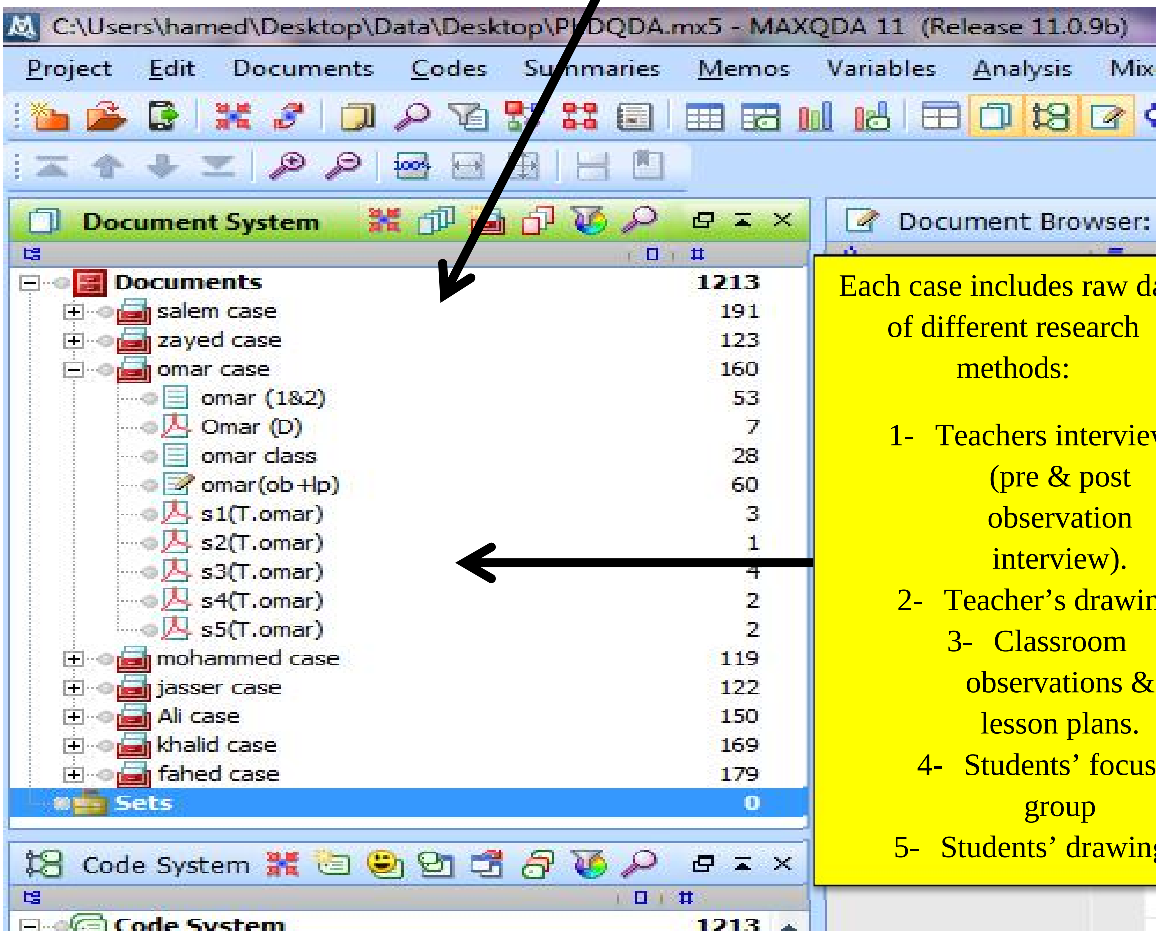
fieldwork	Oct 2012	Nov 2012	Dec 2012	Jan 2013	Feb 2013	Mar 2013	Apr 2013
Ethical clearance	Ethical approval form university of Exeter						
Accessibility	Receiving permissions from relevant administrations						
Pilot study	The last Refinement of methods before piloting	Piloting methods	Starting of main data collection				
School A		Arranging schedules with T. Salem & T. Ali	The case of Salem's class + Ali's class (2nd of Dec2012-7th of Jan2013)		Completing the transcription of verbal data and inserting raw data of the two cases into MaxQda11		
School B		Individual arrangements With both T. Fahed & T. Khalid		The case of Fahed's class + Khalid's class (7th of Jan 2013-10th of Feb 2013)		Completing the transcription of verbal data and inserting raw data of the third and fourth cases into MaxQda11	
School C			Individual arrangements With both T. Omar & T. Mohammed		End term examination followed by short holiday	The case of Omar's class + Mohammed's class (the whole of Mar 2013)	Completing the transcription of verbal data and inserting raw data of the two cases into MaxQda11
School D			Individual arrangements With both T. Jasser & T. Zayed			The case of Jasser's class + Zayed's class (23rd of Mar- 14th of Apr 2013) **(in the end of Apr 2013 the eight cases were inserted in MaxQda11)**	

Appendix G:

Step-by-step example of the thematic analysis model from MaxQDA(11)

Step (1): Management & Familiarity

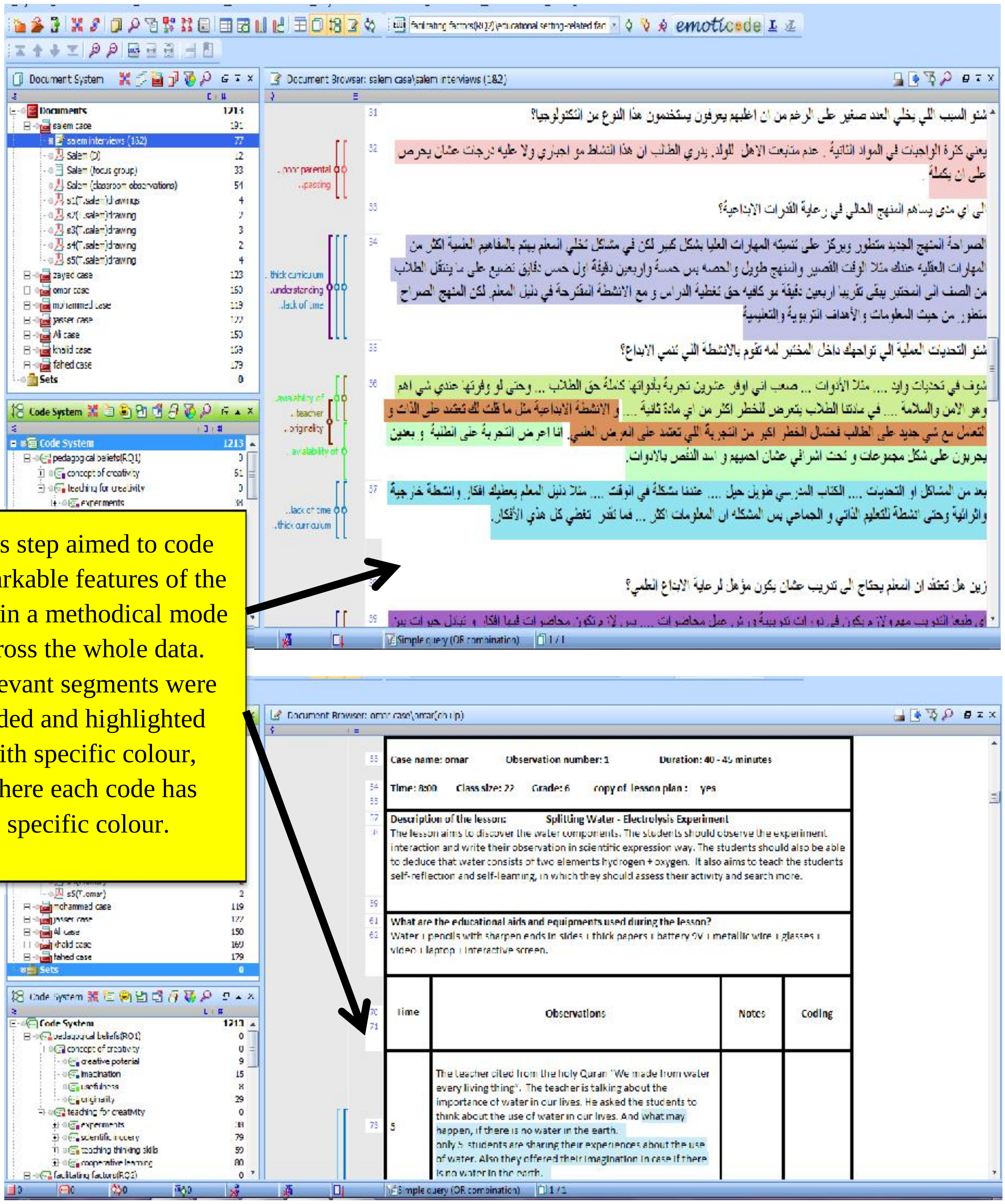
This step aimed to prepare the data and create data set for each case study via MaxQDA. This step included several applications such as transcription, initial reading of the data, and further reading for highlighting preliminary ideas.



Each case includes raw data of different research methods:

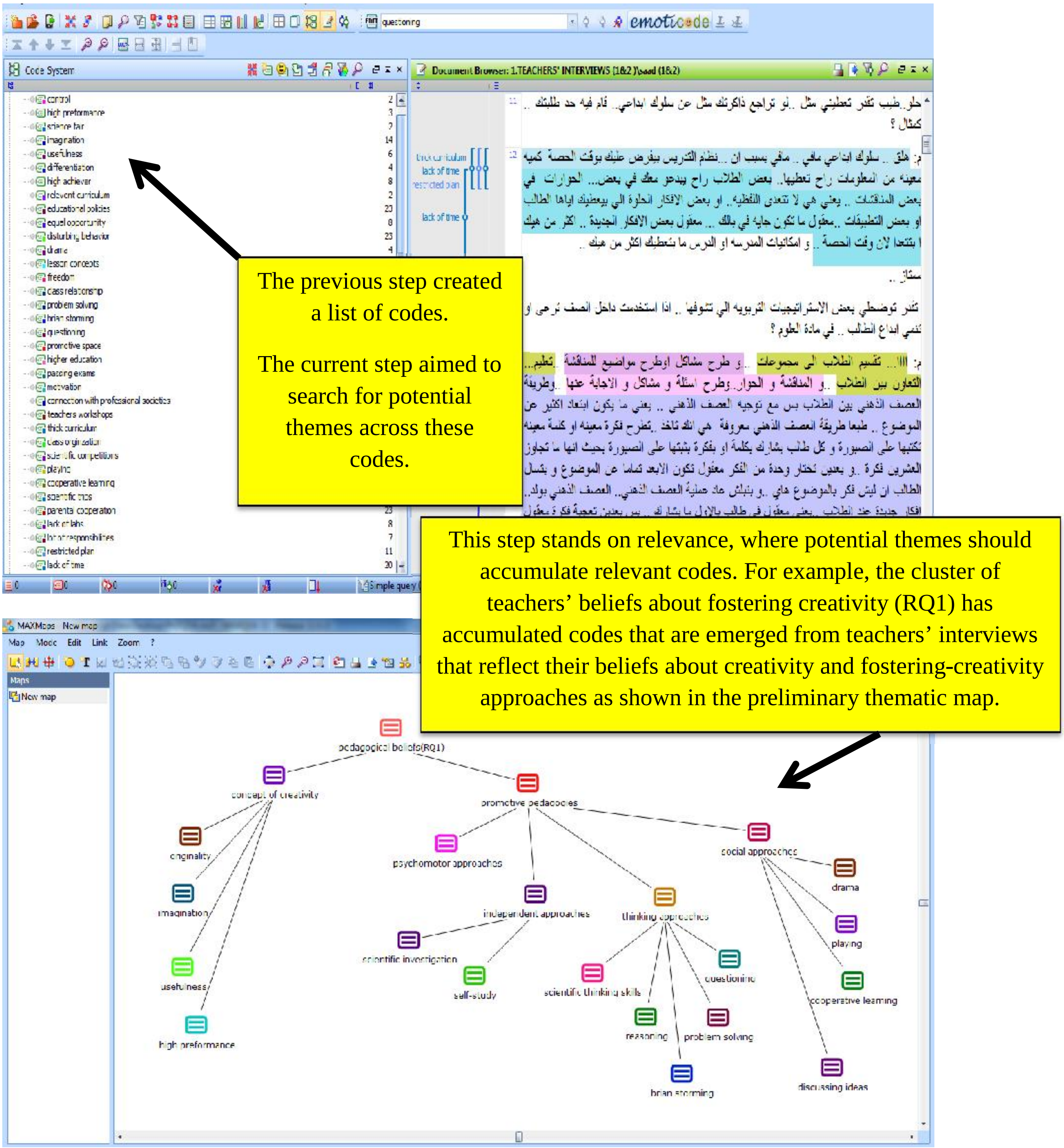
1- Teachers interviews (pre & post observation interview).
2- Teacher's drawing
3- Classroom observations & lesson plans.
4- Students' focus group
5- Students' drawings

Step (2): Generating initial coding (Open coding)

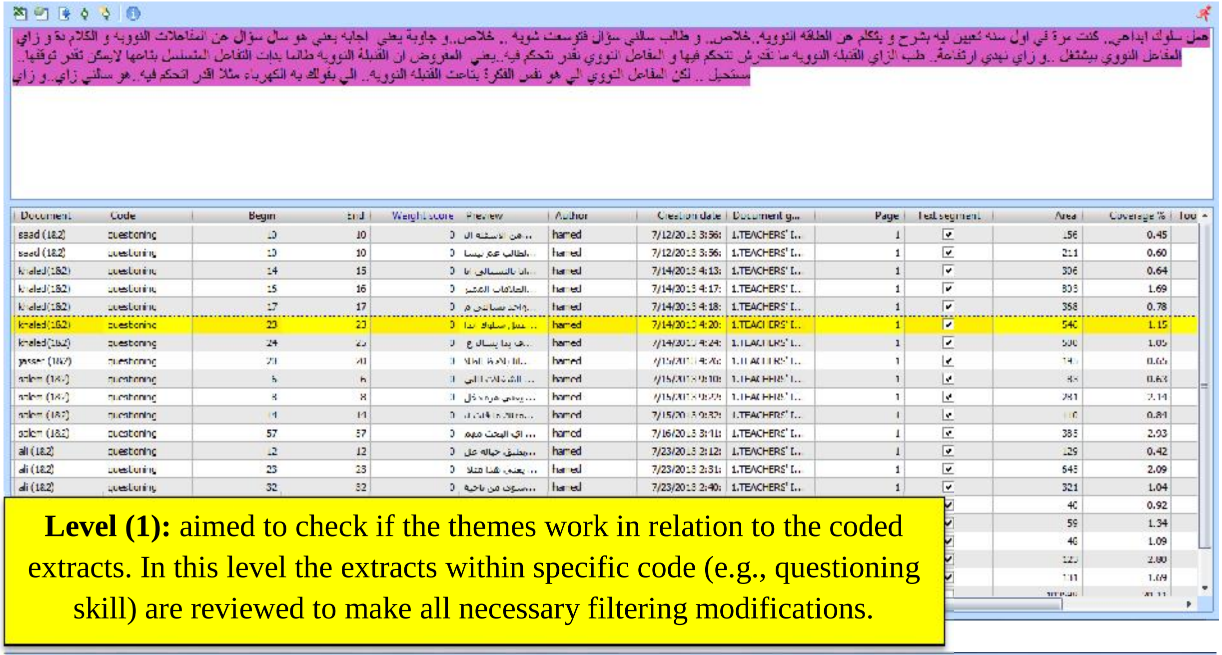


This step aimed to code remarkable features of the data in a methodical mode across the whole data. Relevant segments were coded and highlighted with specific colour, where each code has specific colour.

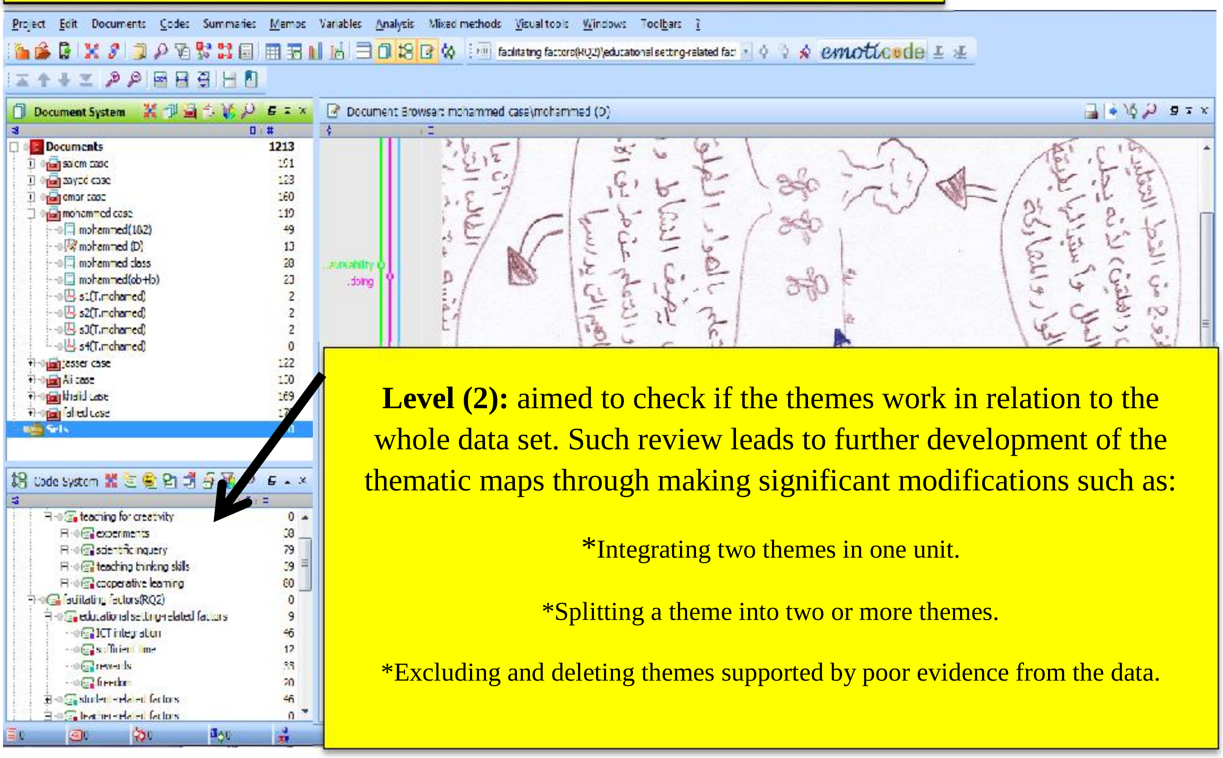
Step (3): Searching for themes (Clustering)



Step (4): Reviewing themes (Two levels of retrieving process)



Level (1): aimed to check if the themes work in relation to the coded extracts. In this level the extracts within specific code (e.g., questioning skill) are reviewed to make all necessary filtering modifications.



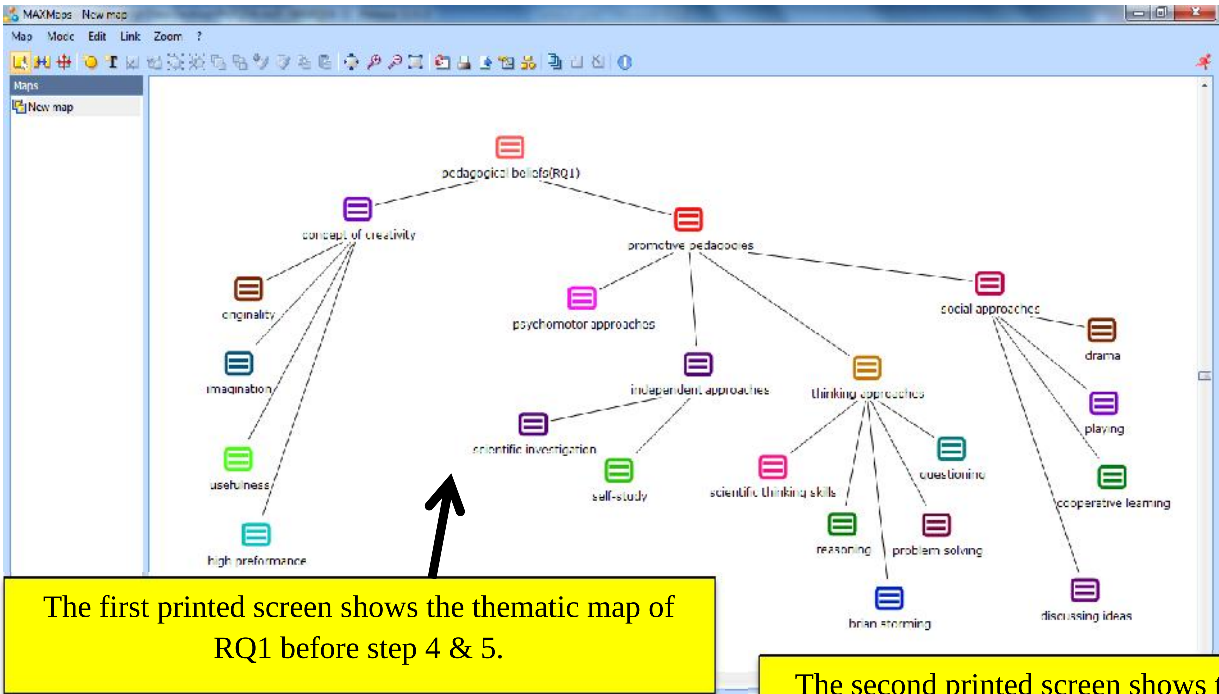
Level (2): aimed to check if the themes work in relation to the whole data set. Such review leads to further development of the thematic maps through making significant modifications such as:

*Integrating two themes in one unit.

*Splitting a theme into two or more themes.

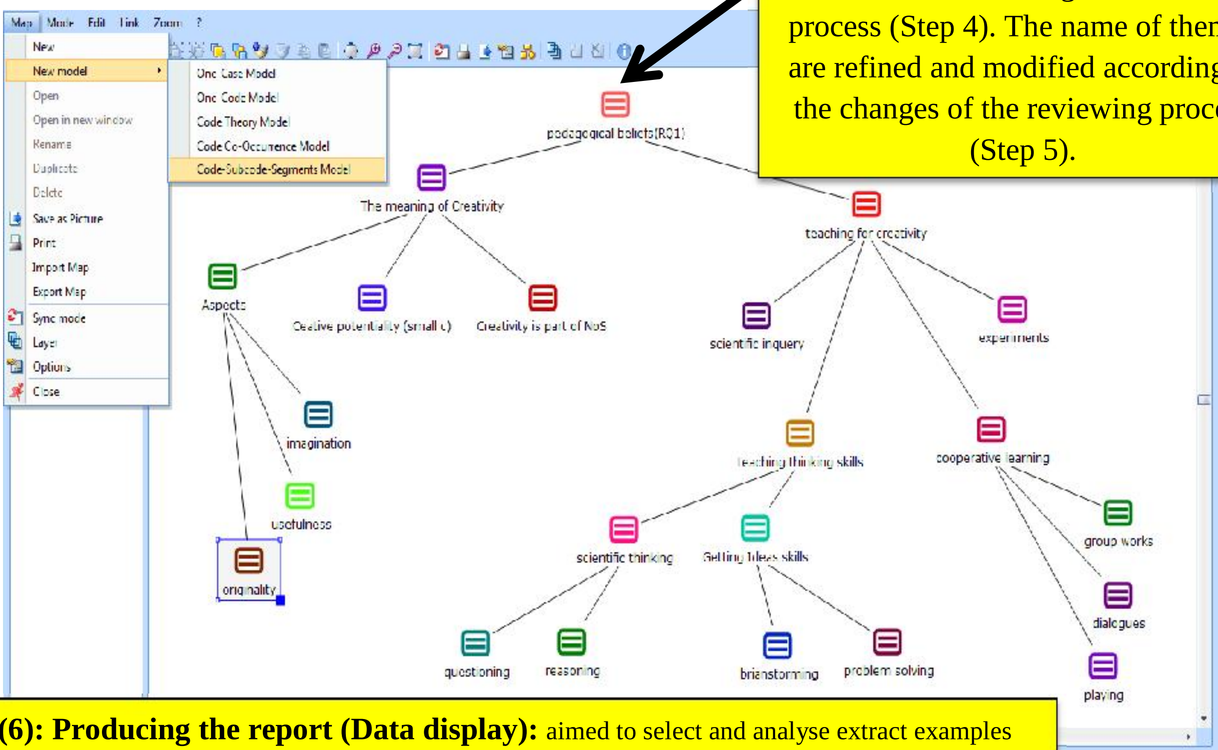
*Excluding and deleting themes supported by poor evidence from the data.

Step (5): Defining and naming themes (Final refinement):



The first printed screen shows the thematic map of RQ1 before step 4 & 5.

The second printed screen shows the final thematic map of RQ1 after the two levels of retrieving and reviewing process (Step 4). The name of themes are refined and modified according to the changes of the reviewing process (Step 5).



Step (6): Producing the report (Data display): aimed to select and analyse extract examples for data display. The final analysis is related back to the research questions and previous literature review to demonstrate and present the findings of the analysis process.

Appendix H:

Information leaflet and consent form for teacher

(English and Arabic copies)

Information Leaflet

Science Teachers' pedagogical beliefs and practices concerning fostering students' creativity in Kuwaiti middle schools: Sociocultural perspective

Dear science teacher,

I am writing to inform you about my study which focuses on exploring science teachers' pedagogical beliefs and practices regarding fostering students' creativity in science classes that is currently being carried out in a number of Kuwaiti middle schools. It is a dissertation project for PhD degree at the Graduate School of Education, Exeter University in England and will be carried out by me. I am writing in hope to ensure that you are willing to participate and have no objection to this research. The Ministry of education has already granted me access to the school and permission to proceed with the research. I am outlining below details of the research envisaged and clarify the nature of your involvement in the study. The research is based on multiple case studies, I would be grateful if you participate as case study in the current research.

Brief description research project:

Briefly, the research aims to explore and explain science teachers' pedagogical beliefs about and practices for fostering creativity in their classrooms in Kuwait. More specifically, the main purpose of the research is to explore these beliefs and practices of science teachers who have academic background or training courses about creativity .This general focus is constructed using various aims that can be summarised in the following manner.

* The study seeks to identify science teachers' pedagogical beliefs about fostering creativity in science classroom.

* It endeavours to explore the similarity and differences between the science teachers' cases.

* It seeks to explore the sociocultural sources that shaped science teachers' beliefs.

* It aims to explore science teachers' practices for fostering creativity in their classes.

* identifying the sociocultural aspects which are taken into account by science teachers in forming their practices.

* investigating science teachers' explanations regarding the degree of consistency between their beliefs and practices.

Your involvement as a case study

Your participation will include several activities such as interview, classroom observations, post observational interviews, collecting related documents, diagrammatic drawing. There are other activities will be conducted with your students that are focus group, journaling, and drawing. To clarify the practical process of your engagement:

You will be asked to be interviewed in order to investigate issues related to your pedagogical beliefs and practices with respect to fostering creativity. Also, I will collect documents of school, science department, and your science notebook. I would also like to observe your practices on five separate occasions (five lessons). After each observation you will be asked to reflect and comment on emergent questions and issues from the observation through conversational interviews (short interviews).also, you are going to draw diagram based on the collected data in order to illustrate your beliefs , practices , and related sociocultural aspects. With respect to the investigation period, the estimated time for collecting the data is approximately 10-15 working days (maximum 3 weeks).

Please, let me know if something is not clear so that I can provide the necessary explanations. Moreover, have in mind that your anonymity will be secured and the information given will be treated under the scope of ethical codes; therefore feel free to express your opinion on the issue examined.

CONSENT FORM

I have been fully informed about the aims and purposes of the project. I understand that:

- 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 for any and no reason
- the findings from this research study will be written into a doctoral dissertation and may be presented in conferences, seminars and written publications

- any information which I give will be used solely for the purposes of this research project, which may include publications

- If applicable, the information, which I give, may be shared between the researcher, Hamed ALsahou, and his PhD supervisors in an anonymised form

- the researcher(s) will make every effort to preserve my anonymity and that of my school and the students

....

(Signature of participant) (Date)

(Printed name of participant) ....

If you have any concerns about the project that you would like to discuss, please contact:

Researcher: Hamed alsahou **Tel:** 00965- 99814958

Email: Hamed_alsahou@hotmail.com or ha253@exeter.ac.uk

PhD Supervisors: Prof. Anna Craft A.R.Craft@exeter.ac.uk and Dr. Nasser Mansour N.Mansour@exeter.ac.uk

نشرة المعلومات

عزيزي معلم مادة العلوم:

أكتب أليك هذا الكتاب الذي هو عبارة عن نشرة توضيحية حول موضوع بحثي والذي يتمركز على اكتشاف مقارن بين المعتقدات والتطبيقات التعليمية لمعلمي مادة العلوم التي تنمي وترعى القدرات الابداعية للطلبة. حيث أن هذه الدراسة تطبق حاليا في عدد من المدارس المرحلة المتوسطة بنين. وهي عبارة عن مشروع أطروحة لدرجة الدكتوراه من جامعة اكستر في إنجلترا، المملكة البريطانية المتحدة والتي سوف اطبقها بنفسي. أنني أكتب أليك وكلي أمل في الحصول على موافقتك بالمشاركة في هذا البحث، وذلك بعد حصولي على موافقة وزارة التربية على زيارة المدارس وجمع المعلومات المتعلقة بموضوع البحث.

لقد كتبت لك فيما يلي وصف ملخص يوضح لك أهداف البحث وطبيعة مشاركتك، وسوف أكون ممتنا جدا إذا تم الموافقة على مشاركتك كدراسة حالة.

وصف ملخص عن البحث:

بالمختصر، الدراسة تهدف الى اكتشاف وتفسير معتقداتك وتطبيقاتك التعليمية التي تعني برعاية قدرات الطلبة الابداعية في مادة العلوم. ودور المؤثرات السياقية (الخارجية) على معتقداتك وتطبيقاتك. هذا الهدف الأساسي مكون من مجموعة من الأهداف الثانوية والتي تم تلخيصها فيما يلي:

أ- الدراسة تسعى الى اكتشاف وتحديد معتقدات المعلم التعليمية حول الطرق والاستراتيجيات التعليمية التي تنمي أبداع الطلاب في العلوم.
ب- كذلك تسعى الى اكتشاف ومقارنة التشابهات والاختلافات بين حالات الدراسة (معلمين العلوم من مدارس مختلفة).
ت- التعرف على المؤثرات السياقية الخارجية التي تحيط معلمي مادة العلوم وتساهم في تكوين معتقداته.
ث- التعرف على التطبيقات التعليمية للمعلم التي ترعى الأبداع في مادة العلوم.
ج- تحديد المؤثرات الخارجية التي يخذها المعلم في عين الاعتبار عند تخطيط وتشكيل تطبيقاته التعليمية.
ح- استقصاء تفسيرات وتبريرات المعلم حول مدى التناسق والتباين بين معتقداته حول رعاية القدرات الإبداعية وتطبيقاته الحالية.

طبيعة المشاركة كدراسة حالة:

مشاركتك سوف تتضمن عدد من الأنشطة مثل مقابلة شخصية، ملاحظات الصف مقابلات قصيرة بعد كل زيارة صفية، تزويدي بنسخه من تحضير الدرس الذي تمت فيه الزيارة، ورسم تخطيطي. كذلك هناك بعض الأنشطة خاصه للطلاب مثل مقابلة جماعيه، رسم تصويري بعد أخذ الموافقة من أولياء أمورهم. ولتوضيح الخطوات العملية لمشاركتك

سوف أقوم بأجراء مقابلة شخصية معك للتعرف على معتقداتك حول رعاية الابداع في مادة العلوم والتطبيقات المناسبة لها. بعد ذلك أود بزيارة الفصل لملاحظة التطبيقات الفعلية داخل الفصل (5 دروس + نسخة من تحضير الدرس) ولتقاط بعض الصور أثناء النشاط العملي للطلبة، تتبعها مقابلات قصيرة تفسيرية حول الدروس التي تم ملاحظتها. وأخيرا طلب منك أن ترسم مخطط كامل يوضح العلاقة بين كل من معتقداتك، تطبيقاتك، والمؤثرات الخارجية ذات الصلة. بالنسبة لفتره البحث أتوقع أن فترة تجميع المعلومات تتراوح بين 10 أيام الى 15 يوم.

ملاحظه: جميع البيانات الشخصية والمعلومات المزودة سوف يتم التعامل معها بسرية ولن يطلع عليها غير الباحث ومشرفيه في الجامعة بعد أخفاء أسماء المشاركين وأسم المدرسة حتى يتمكن المشاركون بالتعبير بحرية مطلقة حول موضوع البحث.

أن كان لديك أي استفسار حول موضوع البحث أرجو عدم التردد في طرح التساؤلات لتزويدك بالمعلومات المناسبة.

صيغة الموافقة

لقد تم أبلاغي حول ملخص الدراسة وأهدافها ودوري بالمشاركة.

وأنا على علم

- باني لست مجبر على المشاركة في هذي الدراسة ولي الحق في الانسحاب لأي سبب او بدون سبب يذكر.
- بأن نتائج البحث تستخدم لأغراض أكاديمية حيث تكتب في أطروحة الدكتوراه وقد تستخدم في المؤتمرات والمجلات العلمية.
- بان من الممكن أن يتم مناقشته المعلومات بين الباحث حامد السهو ومشرفيه الأكاديميين بعد الحفاظ على الخصوصية.
- بأن الباحث سوف يعمل جاهدا لحفظ المعلومات الشخصية والتي تشتمل على اسماء المشاركين وأسماء المدارس في البحث.

اسم المشارك: ....

التوقيع: ....   التاريخ: ....

أن كان لديك أي استفسار الرجاء التواصل من خلال الهاتف أو البريد الالكتروني

اسم الباحث: حامد جاسم السهو

الهاتف: 99814958

البريد الالكتروني: ha253@exeter.ac.uk or Hamed_alsahou@hotmail.com

المشرفين على الاطروحة من University of Exeter

Prof. Anna Craft A.R.Craft@exeter.ac.uk and Dr. Nasser Mansour N.Mansour@exeter.ac.uk

مع فائق الشكر والتقدير

Appendix I:

Information leaflet and consent form for parents

(English & Arabic copies)

Information Leaflet

Science Teachers' pedagogical beliefs and practices concerning fostering students' creativity in Kuwaiti middle schools: Sociocultural perspective

Dear Parents/Guardians,

I am writing to inform you about my study which focuses on exploring science teachers' pedagogical beliefs and practices regarding fostering students' creativity in science classes that is currently being carried out in a number of Kuwaiti middle schools. It is a dissertation project for PhD degree at the Graduate School of Education, Exeter University in England and will be carried out by me. Given that your child class is taking part in the study, I am writing in hope to ensure that you have no objection with respect to your child's participation in this research. The Ministry of education has already granted me access to the school and permission to proceed with the research. I am outlining below details of the research envisaged and clarify the nature of your child's involvement. I would be grateful if you allow me to explore your child perception about the investigated area.

Brief description research project:

Briefly, the research aims to explore and explain science teachers' pedagogical beliefs about and practices for fostering creativity in their classrooms in Kuwait. More specifically, the main purpose of the research is to explore these beliefs and practices of science teachers who have academic background or training courses about creativity .This general focus is constructed using various aims that can be summarised in the following manner.

* The study seeks to identify science teachers' pedagogical beliefs about fostering creativity in science classroom.

* It endeavours to explore the similarity and differences between the science teachers' cases.

* It seeks to explore the sociocultural sources that shaped science teachers' beliefs.

* It aims to explore science teachers' practices for fostering creativity in their classes.

* identifying the sociocultural aspects which are taken into account by science teachers in forming their practices.

* investigating science teachers' explanations regarding the degree of consistency between their beliefs and practices.

Your child's involvement

The project includes exploration of students' perceptions about their science activities and engagements. Therefore, your child's reflections on their learning are an important part of the study. There are four practical engagements in which your child will be involved in.

1- Classroom observation: observing the students' interaction during class activity through some digital images and field notes will be taken by the researcher.

2- Students' journaling: the student will be invited to write a reflection diary on five observed lessons to express his perceptions about how did he learn from the lesson.
3- Conceptual drawing: the student will be asked to express his thoughts regarding science activities through diagrammatic drawing as part of a recorded group interview (see point 4).
4- Focus group: group interview with students (4 to 6 students) in which they will share their opinions with respect to science activities and being creative in science classes.

With respect to the investigation period, the estimated time for collecting the data is approximately 10 - 15 working days (maximum 3 weeks).

Please, let me know if something is not clear so that I can provide the necessary explanations. Moreover, have in mind that your anonymity will be secured and the information given will be treated under the scope of ethical codes; therefore feel free to express your opinion on the issue examined. If you would not like to permit for your child participation, your child will not be asked to involve in the previous engagements. Data will only be collected form students who have parental permission.

CONSENT FORM

I have been fully informed about the aims and purposes of the project. I understand that:

- there is no compulsion for my child to participate in this research project and, if I do choose to participate, I may at any stage withdraw my child participation for any and no reason
- the findings from this research study will be written into a doctoral dissertation and may be presented in conferences, seminars and written publications
- any information which I give will be used solely for the purposes of this research project, which may include publications
- If applicable, the information, which I give, may be shared between the researcher, Hamed ALsahou, and his PhD supervisors in an anonymised form
- the researcher(s) will make every effort to preserve my anonymity and that of my school and the students

……………………………………… ……………………………

(Signature of parent / guardian of participant) (Date)

(Printed name of parent / guardian of participant) ……………………………………………………………………………

If you have any concerns about the project that you would like to discuss, please contact:

Researcher: Hamed alsahou **Tel:** 00965- 99814958

Email: Hamed_alsahou@hotmail.com or ha253@exeter.ac.uk

PhD Supervisors: Prof. Anna Craft A.R.Craft@exeter.ac.uk and Dr. Nasser Mansour N.Mansour@exeter.ac.uk

نشرة لولي الأمر

عزيزي ولي الأمر: تحية طيبة أما بعد

أكتب أليك هذا الكتاب الذي هو عبارة عن نشرة توضيحية حول موضوع بحثي والذي يتمركز على اكتشاف مقارن بين المعتقدات والتطبيقات التعليمية لمعلمي مادة العلوم التي تنمي وترعى القدرات الابداعية للطلبة. حيث أن هذه الدراسة تطبق حاليا في عدد من المدارس المرحلة المتوسطة بنين. وهي عبارة عن مشروع أطروحة لدرجة الدكتوراه من جامعة اكستر في إنجلترا، المملكة البريطانية المتحدة والتي سوف اطبقها بنفسي بما أن صف أبنك مشارك في البحث فأنني أكتب أليك وكلي أمل في الحصول على موافقتك بجمع المعلومات من أبنك في هذا البحث، وذلك بعد حصولي على موافقة وزارة التربية على زيارة المدارس وجمع المعلومات المتعلقة بموضوع البحث. لقد كتبت لكم فيما يلي وصف ملخص يوضح لكم أهداف البحث وطبيعة مشاركة الطلبة، وسوف أكون ممتنا جدا إذا تم الموافقة على مشاركة أبنكم.

وصف ملخص عن البحث:

بالمختصر، الدراسة تهدف الى اكتشاف وتفسير معتقداتك وتطبيقاتك التعليمية التي تعني برعاية قدرات الطلبة الابداعية في مادة العلوم. ودور المؤثرات السياقية (الخارجية) على معتقداتك وتطبيقاتك. هذا الهدف الأساسي مكون من مجموعة من الأهداف الثانوية والتي تم تلخيصها فيما يلي:

أ- الدراسة تسعى الى اكتشاف وتحديد معتقدات المعلم التعليمية حول الطرق والاستراتيجيات التعليمية التي تنمي أبداع الطلاب في العلوم.
ب- كذلك تسعى الى اكتشاف ومقارنة التشابهات والاختلافات بين حالات الدراسة (معلمين العلوم من مدارس مختلفة).
ت- التعرف على المؤثرات الخارجية التي تحيط بمعلم مادة العلوم وتساهم في تكوين معتقداته.
ث- التعرف على التطبيقات التعليمية للمعلم التي ترعى الأبداع في مادة العلوم.
ج- تحديد المؤثرات الخارجية التي يخذها المعلم في عين الاعتبار عند تخطيط وتشكيل تطبيقاته التعليمية.
ح- استقصاء تفسيرات وتبريرات المعلم حول مدى التناسق والتباين بين معتقداته حول رعاية القدرات الإبداعية وتطبيقاته الحالية.

طبيعة المشاركة أبنك:

مشروع البحث يهتم باكتشاف رأي الطلاب حول أنشطة مادة العلوم وماهي الفعاليات التي يقومون بها داخل الفصل. ولهذا رأي ابنك جزء مهم في هذه الدراسة يوضح فيها وجهة نظره كمتعلم. هناك أربع أنشطة للطلبة لجمع المعلومات المطلوبة وهم:

1-ملاحظه الصف: سوف أقوم بملاحظه الأنشطة الصفية مع تسجيل الملاحظات والتقاط بعض الصور عن طريق زيارة خمسة دروس.

2-يوميات العلوم: يقوم الطالب بتلخيص ما قام به من نشاط بكتابة فقرة يوضح فيها كيف تعلم درس اليوم وما الانشطة التي قام بها.

3-رسم مخطط: يقوم الطالب بالتعبير عن رأيهم حول أنشطة العلوم من خلال الرسم.

4-مقابلة جماعية: يقوم الطلبة في مناقشة مواضيع تتعلق بالأنشطة العلمية التي يقومون بها مع بعضهم البعض.

بالنسبة لفتره البحث أتوقع أن فترة تجميع المعلومات تتراوح بين 10 أيام الى 15 يوم.

ملاحظة: جميع البيانات الشخصية والمعلومات المزودة سوف يتم التعامل معها بسرية ولن يطلع عليها غير الباحث ومشرفيه في الجامعة بعد أخفاء أسماء المشاركين وأسم المدرسة حتى يتمكن المشاركون بالتعبير بحرية مطلقة حول موضوع البحث. عزيزي ولي الأمر أن كنت لا ترغب بمشاركة أبنك، فلن أقوم بمشاركته في أنشطة البحث حيث أن المعلومات سوف تجمع من الطلاب الذين لديهم موافقة ولي الأمر.

أن كان لديك أي استفسار حول موضوع البحث أرجو عدم التردد في طرح التساؤلات لتزويدك بالمعلومات المناسبة.

صيغة الموافقة بالمشاركة

لقد تم أبلاغي حول ملخص الدراسة وأهدافها ودور أبني بالمشاركة.

وأنا على علم

- بأني لست مجبر على مشاركة أبني في هذي الدراسة ولي الحق في الانسحاب لأي سبب او بدون سبب يذكر.
- بأن نتائج البحث تستخدم لأغراض أكاديمية حيث تكتب في أطروحة الدكتوراه وقد تستخدم في المؤتمرات والمجلات العلمية.
- بان من الممكن أن يتم مناقشته المعلومات بين الباحث حامد السهو ومشرفيه الأكاديميين بعد الحفاظ على الخصوصية.
- بأن الباحث سوف يعمل جاهدا لحفظ المعلومات الشخصية والتي تشتمل على اسماء المشاركين وأسماء المدارس في البحث.

أسم ولي أمر الطالب: ....

التوقيع ولي الأمر: ....   التاريخ: ....

أن كان لديك أي استفسار الرجاء التواصل من خلال الهاتف أو البريد الإلكتروني

أسم الباحث: حامد جاسم السهو

الهاتف: 99814958

البريد الإلكتروني: ha253@exeter.ac.uk or Hamed_alsahou@hotmail.com

المشرفين على الاطروحة من **University of Exeter**

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مع فائق الشكر والتقدير

Appendix J:

The abbreviation of code's source

Teacher Pseudonym	**Frist Interview (Pre-observation interview)**	**Frist Interview (teacher's drawing)**	**Second Interview (Post-observation interview)**	**Observations No. (1,2,3,4,5)**	**Field Notes**	**Students' Focus Group**	**Focus Group (Specific student) Pseudonym**	**Focus Group (Student's drawing)**
Salem	(S, Int.1)	teacher's drawing (S, Int.1)	(S, Int.2)	(S, Obs. No.)	(S, FN)	(S, St.FG)	(S, FG, St. pseudonym)	Student's drawing (S, FG, St. pseudonym)
Ali	(A, Int.1)	teacher's drawing (A, Int.1)	(A, Int.2)	(A, Obs. No.)	(A, FN)	(A, St.FG)	(A, FG, St. pseudonym)	Student's drawing (A, FG, St. pseudonym)
Khalid	(K, Int.1)	teacher's drawing (K, Int.1)	(K, Int.2)	(K, Obs. No.)	(K, FN)	(K, St.FG)	(K, FG, St. pseudonym)	Student's drawing (K, FG, St. pseudonym)
Fahed	(F, Int.1)	teacher's drawing (F, Int.1)	(F, Int.2)	(F, Obs. No.)	(F, FN)	(F, St.FG)	(F, FG, St. pseudonym)	Student's drawing (F, FG, St. pseudonym)
Omar	(O, Int.1)	teacher's drawing (O, Int.1)	(O, Int.2)	(O, Obs. No.)	(O, FN)	(O, St.FG)	(O, FG, St. pseudonym)	Student's drawing (O, FG, St. pseudonym)
Jasser	(J, Int.1)	teacher's drawing (J, Int.1)	(J, Int.2)	(J, Obs. No.)	(J, FN)	(J, St.FG)	(J, FG, St. pseudonym)	Student's drawing (J, FG, St. pseudonym)
Zayed	(Z, Int.1)	teacher's drawing (Z, Int.1)	(Z, Int.2)	(Z, Obs. No.)	(Z, FN)	(Z, St.FG)	(Z, FG, St. pseudonym)	Student's drawing (Z, FG, St. pseudonym)

Appendix K:

Classification of teachers' beliefs

Teacher	Standards	General indicators of teacher's beliefs	Classification			Level of teacher's belief
			Traditional	**Mixed**	**Progressive**	
Salem	**meaning of creativity**	Newness and usefulness. It is a sort of contribution that benefits the society			√	**Progressive beliefs**
	Teacher's role	Using multiple approaches and creating enjoyment. Supporting new ideas			√	
	Student's role	Study the subject and engage with the lessons to score high marks and to increase their knowledge		√		
	Creative learning	Mutual interaction within free & friendly context. Encouraging students' participations.			√	
	Teaching for creativity	Avoid the traditional approach and apply methods based on solving problems			√	
Ali	**meaning of creativity**	Newness and usefulness. Science is creative subject. Higher achievers are more likely to be creative.			√	**Progressive beliefs**
	Teacher's role	Create opportunities for students to apply science knowledge in different and original ways			√	
	Student's role	Be independent, taking the advantage of the sources of data around them. Follow classroom instructions		√		
	Creative learning	Learn to be productive in society. Being productive requires classroom that transfers familiarity to unusualness			√	
	Teaching for creativity	Applying encouraging activities such as drama, games, group works			√	
Khalid	**meaning of creativity**	The ability of thinking, creativity is a form of thinking. Anyone can be creative.			√	**Progressive beliefs**
	Teacher's role	Avoid direct transmission of textbook information. Think of how to deliver the lessons within new ways		√		
	Student's role	Students should question and reason every information. They need to ask many questions & be curious			√	
	Creative learning	Learning in and out the classroom. Learn through conducting inquiries & investigation to draw new conclusion			√	
	Teaching for creativity	Avoid direct transmission of textbook information. Using strategies that foster questioning reasoning skills			√	
Fahed	**meaning of creativity**	Coming up with new things. Being different comparing to peers. Science subject is creative one			√	**Progressive beliefs**
	Teacher's role	Foster creative students and discuss their thought after the science lesson to save the classroom time		√		
	Student's role	Being independent in their learning, take the advantage of the multiple sources of data around them.			√	
	Creative learning	Doing field trips, conducting enquires, writing scientific reports based on scientific steps			√	
	Teaching for creativity	Add enjoyment in the teaching by applying games to help them to cooperate to enhance their achievement		√		
Mohammed	**meaning of creativity**	Creativity is thinking out of the box. Science subject is full of creativeness and all student be creative			√	**Mixed beliefs**
	Teacher's role	The role is to follow what the system ask them to do to avoid any penalties	√			
	Student's role	Score high marks in the first place to pass exams.	√			
	Creative learning	Participate in out-door activities, and learn through scientific discussion to draw conclusions			√	
	Teaching for creativity	Reduce the activities that stand on dictation style , try to use discussion as teaching method		√		
Omar	**meaning of creativity**	Creativity is excellence, mastering. Everyone is able to preform creatively		√		**Mixed beliefs**
	Teacher's role	Offer space of freedom, supply students with tools and equip the classroom to encourage creativity			√	
	Student's role	Try to succeeded and be higher achiever. Should be independent and curious student. Polite and good listener.		√		
	Creative learning	Learn based inquires and cooperation are required as well as lecturing		√		
	Teaching for creativity	Apply student-centered as well as teacher-centered approaches		√		
Zayed	**meaning of creativity**	the production of new ideas. Very one has a potential to be creative in science subject or in other fields of study			√	**Mixed beliefs**
	Teacher's role	Maintain discipline and follow the striated plan of the ministry	√			
	Student's role	Study the subject and engage with the lessons to score high marks and to increase their knowledge.		√		
	Creative learning	Learning in friendly atmosphere to deliver information and receive comments		√		
	Teaching for creativity	Apply student-centered as well as teacher-centered approaches		√		
Jasser	**meaning of creativity**	Creativity is excellence. Being gifted students with high mental abilities are creative	√			**Traditional beliefs**
	Teacher's role	Mainstream classroom teacher cannot foster creativity. special teacher for gifted should foster creativity	√			
	Student's role	Follow the classroom instructions, Study at home, and read about the assigned topics	√			
	Creative learning	Learn the textbook lessons and prepare student for examination	√			
	Teaching for creativity	Teaching based on free engagement and cooperative activity creates disruptions	√			

Appendix L:

Classifications of teachers' practices

Teacher	Standards	General indicators of teacher's Practices	Classification			Level of teacher's practice
			Traditional	**Mixed**	**Progressive**	
Salem	**meaning of creativity**	new ideas can be fostered in extracurricular classes and outdoor activities instead of regular class		√		**Mixed practice**
	Teacher's role	Teach the textbook content and help student to pass school examination. Developing scientific & life skills.		√		
	Student's role	Pass school examination and get good mark to be able to join higher class and university in the future.	√			
	Creative learning	Encourage independent learning and support after school investigation			√	
	Teaching for creativity	Both teacher-centered and student-centered activities are applied by the teacher		√		
Ali	**meaning of creativity**	Most of class activities aren't subject for fostering creativity, many of them aimed to deliver information		√		**Mixed practice**
	Teacher's role	Meet the students' curiosity and interest. Follow the science mentor instructions & be in line with the plan.		√		
	Student's role	Pass school examination and get good mark to be able to join higher class and university in the future.	√			
	Creative learning	Presentations via smart screen or overhead projector. Sometimes dialogues based on questioning are applied.		√		
	Teaching for creativity	Both teacher-centered and student-centered activities are applied by the teacher		√		
Khalid	**meaning of creativity**	Creative action can be fostered in extracurricular classes and informal activities more than the regular class		√		**Mixed practice**
	Teacher's role	Encouraging questioning and thinking of the given information, when there is enough time.		√		
	Student's role	Be polite and read the textbook to be ready for the next lessons, keep their attention during the lesson.	√			
	Creative learning	Mix between open discussion and direct transmission of textbook information		√		
	Teaching for creativity	Multiple student-centered activities are developed and applied by the teacher. Presentations are also evident.			√	
Fahed	**meaning of creativity**	Support creative actions and ideas in free time and extracurricular class such as students of science club team		√		**Mixed practice**
	Teacher's role	Meet the parental demands regarding their children achievement in exams. Also, meet the students' curiosity.		√		
	Student's role	Pass school examination and get good mark to be able to join higher class and university in the future.	√			
	Creative learning	Interactive learning approaches such as outdoor and indoor learning activities			√	
	Teaching for creativity	Mainly, posing questions to interact with students and reach to factual information (discussion & deduction)		√		
Mohammed	**meaning of creativity**	Creativity is not priority based on the school and society demands. Currently, it means losing teaching hours	√			**Traditional practice**
	Teacher's role	Teach the textbook content and help student to pass school examination. Also, do the demonstrative work	√			
	Student's role	Pass school examination and get good mark to be able to join higher class and university in the future.	√			
	Creative learning	Free engagement was limited. Students receive only the information and ask clarification questions	√			
	Teaching for creativity	Presentations via smart screen or overhead projector. Sometimes practical activities are done by the students.		√		
Omar	**meaning of creativity**	No creative actions in regular class. it is limited to extra and free activities for excellence science students		√		**Mixed practice**
	Teacher's role	Develop the psychomotor skills beside delivering the scientific concepts of textbook		√		
	Student's role	Be polite and read the textbook to be ready for the next lessons	√			
	Creative learning	Group work and discussion is supported by the teacher as well as practical activities.			√	
	Teaching for creativity	Both teacher-centered and student-centered activities are applied by the teacher		√		
Zayed	**meaning of creativity**	Creativity in regular classroom cannot exceed the ability of generating ideas	√			**Traditional practice**
	Teacher's role	Teach the textbook content and help student to pass school examination	√			
	Student's role	Pass school examination and get good mark to be able to join higher class and university in the future.	√			
	Creative learning	Discussion is sometimes encouraged and supported by the teacher; however, it was limited by short time		√		
	Teaching for creativity	Applying lecturing style stands heavily on PowerPoint presentations	√			
Jasser	**meaning of creativity**	Special provision is required for creative students. The current context is not suitable.	√			**Traditional practice**
	Teacher's role	Teach the textbook content and help student to pass school examination	√			
	Student's role	Pass school examination and get good mark to be able to join higher class and university in the future.	√			
	Creative learning	Inactive classroom activities and student are taught in normal class rather than the laboratory.	√			
	Teaching for creativity	Lecturing style with on educational and visual tools to help in delivering the lesson information	√			