



**Pre-service Teachers' Perceptions of Critical Thinking of
Science Instruction and Lesson Planning in UAE's Schools**

تصورات المعلمين المتدربين في تدريس مهارات التفكير النقدي في تعليم العلوم
وتخطيط الدروس في مدارس الإمارات العربية المتحدة

by

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of the requirements for the degree of
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Abstract

This study was done to investigate the pre-service science teachers' perception of critical thinking of science instruction and lesson planning in UAE's schools. A sample size of 80 female pre-service teachers participated in this study from the College of Science Education in different institutions; UAE University, Ajman University and Higher Colleges of Technology in Fujairah, which offer training courses in different private and public schools in UAE. Mixed methods and analysis of lesson plans were used to find explicit study answers; quantitative method was used to find clear answers and was analyzed with SPSS software program; the qualitative method was used to support the quantitative methods results, contributing to the analysis of the lesson plans from different levels in UAE' Schools. The following are the main results in this study from the pre-service teachers' perceptions: (1) The pre-service teachers have approximately the same level of perception about the effect of critical thinking skills on teaching instruction, (2) the pre-service teachers present critical thinking in their science lesson plans in a clear way but they lack the integration of critical thinking skills in an exciting way. (3) The pre-service teachers need more training to raise their experience before getting exposed to the real education environment. In addition, there are no significant differences between pre-service science teachers' perceptions in different years study and their level of teaching.

Key Words: Critical thinking, pre-service teachers' perception, science instruction and lesson plan.

المخلص

بحثت هذه الدراسة في تصورات المعلمين المتدربين في مهارات التفكير النقدي في تدريس العلوم والخطة الدراسية في مدارس الإمارات العربية المتحدة. وشاركت في هذه الدراسة عينة من 80 معلمة من الإناث المتدربات من كلية التربية العلوم الأساسية من مؤسسات مختلفة في دولة الإمارات العربية المتحدة : مثل جامعة الإمارات العربية المتحدة ، وجامعة عجمان ، وكلية التقنية العليا في الفجيرة ، قامت المتدربات بالتدريب في مختلف المدارس الخاصة والعامة في الإمارات العربية المتحدة.

هذه الدراسة استخدمت طرق مختلفة من جمع البيانات الكمية والنوعية وتحليل مختلف الخطط الدراسية من مختلف المستويات منهج العلوم للحصول على إجابات للدراسة الحالية ؛ استخدمت الطريقة الكمية للعثور على إجابات واضحة وتم تحليلها باستخدام برنامج SPSS ، وتم أيضا استخدام الطريقة النوعية لدعم نتائج الطريقة الكمية وفي النهاية تم استخدام طريقة تحليل مختلف الخطط الدراسية من مستويات مختلفة في مدارس الإمارات العربية المتحدة.

النتائج الرئيسية في هذه الدراسة من تصورات المعلمين المتدربين : (1) لدى المعلمات المتدربات نفس مستوى إدراكهم لتأثير مهارات التفكير الناقد على التعليم داخل الحصة الصفية ، (2) المعلمين المتدربين أظهروا طرق مختلفة لمهارات التفكير النقدي الحالي في خطط دروس العلوم بطريقة واضحة ولكنها تفتقر إلى دمج مهارات التفكير النقدي بطريقة أكثر إثارة (3) المعلمين المتدربين بحاجة إلى المزيد من التدريب يميل إلى رفع خبرتهم قبل بيئة التعليم الحقيقية. إضافة إلى ذلك ، لا يوجد اختلاف كبير بين تصورات المعلمين المتدربين في دراستهم في سنوات دراستهم الجامعية المختلفة ومستوى التدريس .

الكلمات والعبارات الرئيسية : التفكير الناقد ، تصورات المعلمين المتدربين ، تعليم العلوم والخطة الدراسية.

Dedication

My ambition to complete the Master's Degree was one of my dreams and biggest challenges.

I dedicate this research to my loving father's soul, as I'm sure he will be proud to witness my success as his enduring propensity for dreaming has inspired my own. May his soul rest in peace.

To my mother, for her ongoing support and strong encouragement to me to take this great step and improve my educational and career level.

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TABLE OF CONTENTS

Abstract
Dedication
Acknowledgements
Table of Contents	i
Chapter 1: Introduction.....	1
1.1 Statement of the problem.....	3
1.2 Rationale of the Study.....	5
1.3 Significant of the study.....	6
1.4 Study Purpose and Questions.....	7
1.5 Structure of the Dissertation.....	8
Chapter 2: Conceptual Framework & Literature Review.....	9
2.1 Conceptual Framework	9
2.2 Literature Review.....	11
2.2.1 The History of Critical Thinking	11
2.2.2 Nature of Critical Thinking.....	14

2.2.3 Critical Thinking in Teaching and Learning Science.....	17
2.2.4 Role of Critical Thinking in practical Science	20
Chapter3: Methodology.....	22
3.1Research Design.....	23
3.2.1Site, Sampling and Participates	25
3.2.2Instruments.....	26
3.2.2.1 Science Pre-Service Teacher Questionnaire	27
3.2.2.1.1Validity and Reliability of the Pre-Service Teacher’s Questionnaire.....	29
3.2.2.1.1.2 Pilot Study.....	30
3.2.2.2Science Pre-Service Teacher Interview	30
3.2.2.3Lesson Plan Analysis	31
3.4 Data Analysis.....	34
3.5 Ethical Considerations.....	35

Chapter 4: Results and Data Analysis	35
4.1 Demographic Information	36
4.1.1 Science Pre-service Teachers’ Perceptions of Critical Thinking skills based on Years of University and level	37
4.2 Pre-service Teachers’ Perceptions of Critical Thinking Skills	38
4.2.1 Pre-service Teachers’ Perceptions about the Effects of Critical Thinking Skills on Teaching Instructions	38
4.2.1.1 The Effects of Critical Thinking Skills on Pre-service Teachers’ Way of Teaching	40
4.2.2 Pre-service Teachers’ Responses to the Qualitative Data “Interview”	42
4.2.3 Pre-service Teachers’ Present Critical thinking skills During the Lesson Plan.....	44
4.3 Summary of Results	45

Chapter 5: Discussion and Conclusions.....	46
5.1 Discussion.....	47
5.2 Conclusions and Implications.....	50
5.3 Limitations	52
5.4 Recommendation for the Field	53
5.5 Recommendations for Further Research.....	54
References	55
Appendices.....	65
Appendix 1:.....	65
Appendix 2:.....	66
Appendix3:.....	68
Appendix4:.....	71
Appendix5:.....	72
Appendix6:.....	73
Appendix7:.....	84

List of Tables

Table1: Study Methods.....	24
Table2:Percentage of pre-service teachers’ demographic information.....	37
Table3: Science pre-service teachers’ perceptions of critical thinking skills based on years of university and grade level	38
Table4: Percentage of Science Pre-service Teachers’ questionnaire.....	40
Table5: The Effects of Critical Thinking Skills on Pre-service Teachers’ way of teaching.....	42
Table 6: Lesson plan analysis	44

List of Figures

Figure 1: The research design of the study	25
Figure 2: The mean and standard deviation of all questions in the questionnaire	46

Chapter1: Introduction

Critical thinking skills are essential for scientific education science field and practice which individual needs to make decisions, communicate ideas, analyze and solve problems. Critical thinking is a concept that should not be confused with intelligence and it is a skill that can improve in everyone. Teaching and learning have witnessed a big development in many countries and influenced by many different factors. However, the development has taken place in all ingredients of education such as curriculum, teachers, students and education policy. This development in education system has launched many important new terms such as creative thinking and critical thinking. Thinking elements such as openness accuracy, competence, depth, breadth and certainty are important in critical thinking activities (Nosich, 2012). Many researchers tried to explore the reasons and components of the science curricula that don't contribute in the critical thinking level, as well as to correlate between the critical thinking skills and different variable such as teachers' gender, teaching style and students' level. It is a cognitive process and it enhances problem solving, decision making and another important skills. The cognitive process is important to process complex information. It is important that individuals can use their own cognitive strategies and manage themselves in different dimensions (Chemers, Hu&Garcia, 2001).

The term critical thinking is a vital term as its skills are being taught by many teachers. On the other hand, thinking skills have odd features that an individual should think with their ideas and compare it with logical standers. It is an open-minded, problem discovery, conceptualize, problem, plan and developing strategies, understanding, seeking the truth, working and reflecting on mental process (Tishman, Jay & Perkins 1993). Coalitions of National Organizations have highlighted the importance of skills as it plays a major role in future development of problem solving (Halpren, 2014). The most important points that support and cultivate the critical thinking are vital questions, relevant information, alternative solutions for complex problems and finally the conclusion. Thinking critically is self-monitored and self-directed, the reasoning of critical thinking is to clarify the purpose and to choose the realistic purpose. The reasoning is based on data and attempts to precisely state the strengths and weaknesses of questions and identify the appropriate answers. The kind of questions is for knowledge, opinion and judgment. Furthermore the critical thinking reasoning is shaped by ideas, concepts and inference as

conclusion. Teachers should prepare the students to think critically and ask them questions that guide them to better reasoning. Terrorism and ill thinking in many parts of the world need to be combated by educating generations to evaluate life by healthy reasoning and higher-order thinking skills (Forawi, 2016).

Critical thinking has been the most important factor to develop the education system. According to Paul, there most essential terms in critical thinking are analyzing, assessing and improving. The thinking starts the process with analyzing the information then assessing and inferences to improve the thinking. However, neither students nor teachers seem to have made the appropriate development of critical and creative thinking skills to date (Forawi & Mitchell, 2012). Offering of the teacher to students an appropriate environment for thinking that enhances more opportunities to develop their thinking levels and give their students a confidence to express their ideas. The students spend significant times in school to learn the basics concepts and the teachers set goals that enhance their basics to increase their level of thinking. In addition, the Teachers influence in education system and students through their behavior and attitudes, the students are given a chance to support their education system.

21st century skills are developed and presented into three parts (1) innovation skills such as critical thinking, (2) Digital literacy such as media literacy and (3) life skills such as social and cross-cultural, the main responsibility to encourage students to develop 21st century skills are the educational institution and teachers. Critical thinking skills have conditions that are based on different standards, specific structure and features. According to the Nickerson (1987), characteristics of critical thinking help the individuals to predict and evaluate their assumptions. Using evidence to support the assumptions, organize and express the thoughts, find alternative action, Discrimination between the reasonable and unreasonable and find the similarities.

Teaching critical thinking skills methods are illustrated in many behaviors such as creativity, gaining new information and concepts, manipulative skills and judgment. According to Emerson (2013), the critical thinking teaching is guided by four important approaches. First, Mixed approach, which is a collection between the general and specific approaches. The teachers enhance the most important principles of critical thinking and apply it in real life and students draw the certain context to inference the information. Explicit instruction in critical thinking skills can be incorporate into both general and specific components (Ennis, 2011). The second

approach is immersion approach that is understanding the content deeply and emphasizing in to consider these ideas and information which are important to develop higher level of thinking and also increase dialogue during learning between the students and teachers. In Rerun, students are expected to acquire these skills as a natural consequence of their engagement with the subject matter (Ennis, 1989). Immersion approach is related to the infusion approach is critical thinking principles with in-depth instruction, explicit instruction and subject matter. Thus, enhance the thinking skills in the content. The last approach is general approach, instruction in general thinking skills, taught as a —broad-based, cross-disciplinary course, to be the most effective way of teaching critical thinking (Haplen, 2001). Generally, either direct or explicit approaches, skills involved are common and each doesn't encounter specific information. Rather, it concludes examples and developed skills. Some of the scholars who defend these approaches include Bailin, Case, Coombs and Daniels (1999), Lipman (1988), Silva (2008), Case (2005). Court (1991) claimed that critical thinking approach is divided into five methods: process approach, logical approach, problem solving approach, information approach and multi-aspect approach. 21th century skills characterized to assessing critical skills in to two main features; awareness and ongoing criticism. Hatcher (2006) clarified teaching critical thinking as “stand-alone” which provides the learner with abilities and skills as well as “specific discipline” which is logical to increase the thinking capacity. Abrami et al. (2015) used Ennis's (1989) approaches, which consisted of four teaching methods to teach critical thinking. The three major components of critical thinking skills are based on argument (Browne & Keeley, 2015), changing beliefs (Stanovich, 2011) and well-documented thinking errors (Kahneman, 2011). Critical thinking skills in the field of education have many diverse ways of being taught and applied.

1.1 Statement of the problem

The important role for teachers is to prepare the students to be successful in their education and teach the students how to think not what to think (Keogh, 2014). This should be enrolled by colleges in the science circular for their future employees (Association of American Colleges & Universities, 2010). Many studies claimed that the interaction between the students and teachers are required to enhance the education and critical thinking skills as it is a significant element to

increase the interaction between students- teachers and students- students. The role of the school is to enhance the critical thinking skills because it is considered a type of thinking that will help students to solve their problems inside and outside the school more practically. In general, there are several schools in basic education that employ teachers and specialists to make these skills standards more efficacy (Smith & Szymanski, 2013). There are several reasons in which the teacher does not focus on the skills of critical thinking because of the lack of definition of critical thinking, how to teach, learn it and whether this skill is learned through the natural life and society awareness so that this skill is important in strengthening students in schools. Weeks (2012) argues that elements of reasoning should become important during teaching and learning.

The correlation between the science education and critical thinking skills is positive. Elder and Paul (2008) and Weeks (2012) claimed that restructuring of teaching and learning science education is very important in order to improve the critical thinking levels of students. It plays a very important role in basic problem solving (Liu, 2014). The skill of critical thinking in teaching science is an effective skill in the development of scientific and technological approaches. Gunn et al. (2014), the most significant skills of critical thinking in science education, to demonstrate the important scientific concepts such as analyzes of information, observation, involving previous experiences and making decisions as well as critical thinking skills are established in the laboratory which depends on various activities and requires skills of it and cooperation between the students to solve scientific problems in a particular context and laboratory activity established in critical thinking skills practical science. Bailin (2002), said that the practical skills that students receive in a lecture it is, as cookbooks do not develop the student's critical thinking skills. The skill of critical thinking is a practical and intuitive skill as well as it depends heavily on the teacher who plays an important role in developing students' thinking levels teacher provides the opportunity to support activities that support and assist students in developing critical thinking.

1.2 Rationale of the study

Many Educational institutes and curriculum coordinators agreed that students need to develop critical Thinking skills in the 21st century because the modern life has encountered new information that requires an individual to thinking deeply. The most important question remains what is the right information?. Many studies showed that critical thinking skills can be improved through continuous training as it has a significant impact on improving skills such as problem solving, planning, and making right decisions (Zulfiqar, 2016). Many researchers encourage teaching critical thinking in all levels of education (Luukkonen, 2008). It has become an essential tool for teaching and learning science in schools as it is contributory to the analysis of ideas and acquiring other skills. In addition, the simplest definition that critical thinking skill is a process of presenting evidence and building judgments.

The UAE is working on developing several fields of education which target certain goals that will improve education of science more than the previous years to be ranked as one of the top 20 positions in education, the top 15 positions in student performance in the science subject, ensuring higher level in thinking skills in future. Science curriculum should be modified to meet important skills, requirements for teaching and learning approach to enhance and improve critical thinking skills by using bloom's taxonomy style (The UAE National Agenda, 2014). The educational institutions working on developing teachers how to teach different skills, including the skills of critical thinking but few of teachers learned how to teach this skill effectively. Most of pre-service science teachers do their training courses in fields of science education in different public and private schools in UAE and they know about critical thinking importance but most educational institutions have given little importance to the effectiveness of critical thinking. Most of teachers lack scientific background, effectiveness, appropriate strategy and have low confidence in science teaching (Lewis, 2014).

The most common issue between pre-service teachers and in-service teachers that what is the best and effective way that the teachers can teach about critical thinking in science. The amount of massive information may be received by students in a negative way, which may affect the education of science in a negative and alienate the student from learning, students need to develop some skills such as critical thinking skills and apply it in the real world (Oliver &

Utermohlen, 1995). To enhance the importance of critical thinking by asking the appropriate questions and think in critical way that will increase the level of students learning science. Teachers focus on it as it has developed skills such as analytical thinking. Most of teachers have compared critical thinking skills to higher thinking skills such as Bloom's taxonomy (Bloom et al., 1974; Ennis, 1981). Ennis argues that this taxonomy is insufficient. Some basic courses require teaching students complex texts that provide a lot of basic facts in the fields of science and this will set a challenge for students to push them to raise their levels of thinking and problem solving skills (Briggs, 2014).

1.3 Significance of the study

The teaching of critical thinking is an essential goal that must be pursued from teacher to help students to address issues, facing different situations and develop their abilities to explore and solve problems. The importance of teaching critical thinking through points; It makes us more honest with ourselves, gives us a possibility to understand different views, evolution of the listening ability. Communication skills including oral and written skills (Živkovic, 2016), it gives students a manner to understand subjects, such as logic and history, develop the ability to use our minds rather than our emotions, identify our feelings in logical way, it also develops an interaction between the society, sense of political participation, it also encourages discussion and dialogue, develop the ability to communicate between teachers and students. The critical thinking skills largely develop the student's reasoning and dialogic (Moon, 2008 ;Paul& Elder, 2004) it also improves awareness of issues on the global, regional and local critical spirit and it can improve the individual's ability to self-learn understand cultural differences among civilizations and contribute to interfaith dialogue and intercultural dialogue.

The teaching of thinking is one of the most important goals that educational system seek to achieve in their educational institutions, intensified efforts, harnessed the possibilities and prepares programs to make students more willing to adapt to the conditions of life around them and deal with the problems. A controversial opinion has recently been raised that the ail students fail on their examinations due to the weakness of the mental abilities based. Teachers consider that critical thinking is one of the most difficult skills that students have difficulty acquiring and they measurement of the students' levels is based on examinations that are based on memorizing

the information (Al-Rubaie, 2017). Integrating the skill of critical thinking into the curriculum is a combination of teacher efficiency and government support (Varga & Rahaela, 2011). Pre-service teachers thought that teaching critical thinking skills to students must be in pre-school level and claimed that they have a positive side to develop the skill of critical thinking for students in the future (Akinoğlu & Karsantik, 2016). Many studies and researchers have concluded that the skill of critical thinking is effective when taught directly. Teachers provide with the critical thinking courses that increase the students thinking level (Abrami, et. al, 2008; Heijltjes, Van Gog & Paas, 2014), peer-to-peer interaction enhances the role of critical thinking development for students (Davies, et al., 2013). At the beginning of the 21st century, the role of critical thinking became central to curriculum and education (Chouari, 2016). Therefore, most countries of the world have included critical thinking skills into their curricula and in different levels of education. Teachers who have advanced skills of critical thinking and problem solving make it easier for students to develop different skills (Evans, 2008 & Fullan, 2001& MEB, 2012). There are many goals related to critical thinking skills and related to school curricula (Bensley, 2011). The institutions challenge is prepare pre-service teacher to pursue training programs that prepare pre-service teachers to develop their students' critical thinking.

1.4 Study Purpose and Questions

At the researcher best knowledge this research is the first one to be conducted about the purpose of this study is to investigate pre-service teacher's perceptions of critical thinking in science instruction and lesson planning in UAE' schools. In this research, it focuses on critical thinking skills, which is identified as an important skill in teaching and learning science. This study is undertaken to address with the following main questions:

- 1- What are the UAE pre-service teacher's perceptions of critical thinking of science instruction?
- 2- How do UAE pre-service teacher present critical thinking in science lesson planning?
- 3- What demographic differences, if any, do pre-service teachers' perceptions have regarding critical thinking?

The pre-service teachers are in second, third and fourth years of university and they teach an American and British curriculum elementary level between 7 to 12 years old in private and

public schools in Alain, Ajman and Fujairah, UAE schools. The participants are 80 female pre-service teachers and most of them have a background about critical thinking skills. In this study, mixed methods used to find specific explicit answers to different questions. Firstly, questionnaires of closed-ended questions and interview is used to cover the study questions and specify concise open-ended questions to investigate pre-service teachers' perceptions of critical thinking in science instruction and lesson planning in UAE schools. Secondly, lesson plan observation is used from pre-service teachers during the classroom to consider how the pre-service teachers enhance critical thinking during the classroom.

1.5 Structure of the Dissertation

The first chapter has presented the study title, study purpose, description of the problems, the questions that will construct the study and its relation to the problem as well as explaining the context of this study. The second chapter show the literature review that includes the previous studies in critical thinking, the conceptual framework of critical thinking skills, previous literature on pre-servicer teacher teach critical thinking skills and different kinds of work has been done and considered. The third chapter demonstrated the research methodology that described this study, participation, designed approaches that followed “qualitative method and quantitative method”, test the study questions to reach to the goals, collecting data and analyses of the data through SPSS program to find the results. The fourth chapter shows the data analyzed “interpretation the data” to find results, the subject understanding and different point of views and opinion related to the results. The last chapter in this study presents the conclusion that is briefly explained the problem statement, the purpose that constructs the study as well as the limitation, implications and recommendation that suggest future work and future studies and develop further ideas to enhance critical thinking skills.

Chapter 2: Conceptual Framework & Literature Review

The chapter discusses the literature review and conceptual framework of the study as components. It includes multiple discussions, components and many sections such as problem statement and their implications.

2.1 Conceptual Framework

Many researchers have failed to come to a consensus regarding critical thinking skills' definition and further research is still under process to reach it. (Bailin, 2002&Willingham, 2007).The theories of education differed to include most of the problems faced by the teacher within the classroom; the pre-service teachers should understand most of educational theories widely to face the education problems during the teaching and learning. The critical Thinking definition and theories are confused and most of the theories are designed to find the different between the thinking levels. Critical thinking skills defined integrate values and beliefs into the formation of knowledge (Paul, 1985 & Facione, 1990). This is to achieve a good thinker's level in terms of knowledge, abilities, use of evidence as well as problem solving.

Many researches shared philosophical educational theories in critical thinking skills and more defensible assumption. In this study, I will use Paul-Elder critical thinking model to support my study, the framework of Paul-Elder in critical thinking is to make a best way to integrate critical thinking in the world. It is easy to understand the concepts of critical thinking through several different studies conducted in critical thinking which contribute to clarifying the basic tools and principles of critical thinking that help to be deeper in the critical thinking skills. Elder and Paul (1994) suggested that critical thinking is best understood as the ability of thinkers to take charge of their own thinking. Also Harris and Hodges (1995) declared critical evaluation as the process of arriving to a judgment about the value or impact of a text by examining its quality.

Waugh and Duron in 2006 identified five models of critical thinking skills through the different theories and practices. The first model is determining the goals which are through the students' behavior inside the class room such as the teacher asks the students basic question "who, what.....est. to decide the level of thinking, the students in this level can explain, memorize, compare and describe the information. John Dewey American philosopher claimed that the

critical thinking is a reflective thinking, active process, persistent and careful. It calls for a persistent effort to examine any beliefs or supposed form of knowledge in the light of the evidence that supports it and further conclusion to which it trends (Glaser,1941, p.5). The second model is ask the divergent questions, appropriate question and use techniques that encourage the students. Clasen and Bonk (1990) posited that although there are many strategies that can have an impact student thinking, it is teacher questions that have the greatest impact. Furthermore, Elder and Paul (1997) identified that the questions is a foundation part and guide the students to seek about facts and information. Teachers can and should use questioning techniques to inspire critical thinking in the classroom (Waugh & Duron, 2006).

The third model involves the students in different activities to promote critical thinking skill, the teachers are support the lesson plan with different activities in which the students are more enjoyable in learning science, To make teaching and learning more active, it is about how to add different activities that make science classroom more effective and interesting to the students. Fink (2003) mentioned that there are principles that guide the activity learning such as sources observation, dialogs, reflective thinking, and write the results on reports. The fourth model in teaching the students is a review that depends on teacher monitoring and students' feedback for example identify the important points and discuss the students' response.

Angelo and Cross (1993) suggested numerous methods for collecting key information related to student learning and response to instructional techniques. The students' feedback is a significant tool to develop many important skills to determine the students thinking levels. The last model is assessment of the critical thinking level that through students' self- assessment and improves the instruction, the feedback guides the teachers and the students to create the educational system to be more successful, the distinction between successful standers and unsuccessful standers and generate the trust between the peers. According to Wlodkowski and Ginsberg (1995), teachers should provide feedback that is informational rather than controlling, based on agreed-upon standards, specific and constructive, quantitative, prompt, frequent, positive, personal, and differential (i.e., indicating personal improvement since the last performance).

2.2 Literature Review

The literature review in this study is a range of previous literature reviews about critical thinking in teaching and learning science. This chapter shows the history of critical thinking, nature of critical thinking, critical thinking in teaching and learning science and role of critical thinking in practical science.

2.2.1 The History of Critical Thinking

Critical thinking is not a new term. In fact, it has been a particular concern in Russian literature history (Rosalina T 2016). It has been recognized for years as the most important goal that promotes education and effective during decision-making (McMillan, 1987). The critical thinking skills have been started from centuries and lately have received a lot of attention in all levels of education in many countries, particularly Southeast Asia. 21st Century Skills have played a role in expanding the critical thinking movement and are identified as one of several learning and restoration skills necessary to prepare students for education and the professional domain. The roots of critical thinking extend to the ancient Greeks and to Socrates' education (Zascavage et al. 2007). Therefore, the learning model should shift from traditional learning which confirms the low level thinking skills towards learning that confirms higher-order thinking skills, especially critical thinking. Socrates' discovered the people could not analyze their knowledge in rationally methods and clarify that asking deep question lead to finding evidences and accepting the ideas. The Greek Philosophers like Plato and Aristotle identified the trained minds need realities to understand and think consistently to reach and discover things (Kreis, 2000).

In Middle Ages the thinkers believed that one who are thinking critically do not reject basic beliefs as Thomas Aquinas identified that critical thinking needs examine the reasoning. Critical Thinking is the ability to analyze the way you think and present evidence for your ideas (Islam 2015). In 15th and 16th centuries the thinkers assumed that most fields in human life needs analysis and thinking in a critical way such as society and religion as Erasmus and Moor from England. Also in 18th and 19th centuries the thinkers developed the critical thinking conception

extended as a tool to solve different problems in economic fields. In England Francis Bacon claimed that the mind can't be safe in normal tendencies and he found a book "The Advancement of Learning" that considered as an earliest book in critical thinking after 50 years in France the author Descartes established a book under title "Rules for the direction or the mind" which was considered the second book in critical thinking.

In 20th century the power of critical thinking has been raised and extended to be more explicit and to include more domains in human life. In 1906 William Graham Sumner published to the tendency of the human mind to think socially in a critical manner. Ennis (1996) said that it is important to critically think for the survival of a democratic way. Edward (1941) divided thinking in critical way into three ways. First, experiences are important to think in problems and complex issues. Second, logical and reasoning are basic in critical thinking. Third, skills are required to apply experiences and reasoning in critical thinking. Critical thinking needs support, efforts and evidence to test any beliefs. In general way particular purpose skills need be able to understand the problems, find the requirements to face problems, collect and marshal information, understand the assumptions, use accurate languages, interpret information, find and evaluate evidences, find the logical relationship between the arguments, draw and come to conclusion. Also Glaser (1941) developed the critical thinking concepts to assess the facts that support the conclusion. Glaser and Russell in 1960 claimed that critical thinking needs logical data far from imagination. Many researches today consider critical thinking as a "contentious skills" and the controversially support to define critical thinking and how to assess the effects on students life inside schools. The lack of an accurate definition of critical thinking is also a reflection to literature on teaching and assessing critical thinking in different areas and disciplines (Ennis, 1993; Facione, 1990; Paul, 1989).

The most popular definitions in critical thinking is that for Ennis 1989 "Critical thinking is reasonable reflective thinking focused on deciding or what to believe to do". Critical thinking is used as cognitive skills to increase positive learning outcomes. According to the Bonk & Maholmes in 1996 critical thinking is reasonable and reflective. In 2003 Halpern claimed more definition in critical thinking such as finding problem solving, finding evidences, and using the text to work with problems that need more thinking. The mental process, strategies and representations people use to solve problems, make decisions and new concepts (Sternberg

1986). Thinking in a critical way is a tool to face problems with performs appropriate actions (Lipman 1995)

In 1989 Ennis classified critical thinking to include dispositions, abilities and skills that interrelate the concepts. The philosophers and researchers identified critical thinking as educated behaviors. Norris' view in 1994 claimed that it is a disposition as individuals thinking critically under conditions and is not a predilection and individuals should use different abilities they possess. (Dam & Volman 2004, Facione, 1990) supported that critical thinking includes concepts of skill and disposition. Turkoglu and Consoy in 2017 examined the pre-service teachers to find the relationship between the critical thinking skills, disposition and to solve problem skills. The pre-service teachers were in different years in university, the data analyzed through examination of the variables. The results that revealed that pre-service teachers disposition in critical thinking skills and problem solving was low, the authors suggested to provide the pre-service teachers students with different practices to implement different skills such as the critical thinking disposition and solve-problem.

Recently, in 2013 Facione claimed that critical thinking is a judgment which results should be interpretation of experiences and judgments, analysis of concepts and information, explanation of data in a reasonable way, evaluation of the information and methodology which is judgment based. Also Hunter (2014) has specific deeper ideas about critical thinking and considered it essential for personal autonomy. The stages of critical thinking differ from childhood to old ages. It is challenging our personal beliefs also changing the critical thinking values. In its exemplary form, it is based on universal intellectual values that transcend subject matter divisions into clarity, accuracy, precision, consistency, relevance, sound evidence, good reasons, depth, breadth, and fairness" (Scriven and Paul, 2008). The process of thinking in critical way is appropriate for individual opinion, thoughts in social problems and discussion in different cultures issues. The people who are thinking in critical ways will struggle to find the reasonable issues. Beyer (1985) also pointed out that individuals should have the ability of critical thinking for making correct decisions on the issues related to personal, social, economic, political and citizenship matters in order to catch up with the accelerated change in the world and to maintain democracy successfully.

The history of critical thinking has been developed important definitions of critical thinking over thousands of years by many philosophers and researchers. The definition of it is very complex and depends on specific skills and can change the definition according to different people's perceptions about things and their behaviors.

2.2.2 Nature of Critical Thinking

The nature of critical thinking is very deep. In general, people think and take vary various decisions. Understanding how other people think is very important. Nature of critical thinking is guided by logic, aids to ask appropriate questions, collect information and analyzes it. It is a collection from logical, demonstrative, skills and human conducts which develop the abilities to explore the important aspects in analyzing and evaluation the arguments in human logic. It is to generate the logical questions to find different solves. Halpern' (1996) studied that cognitive skills or strategies increase the likelihood of the desired behaviors. A thinker person should examine his beliefs and assumption in reasonable way.

The philosophies concluded that natures of critical thinking are reflective and ethical. It needs practices to develop the level of critical thinking such as different activity engagement, map skills and the ability to identify the truth. Vann Gelder (2005) claimed that improving critical thinking abilities require practice and to be actively engaged in the skills of it. When we search about critical thinking, we will find two branches; the creative thinking and problem solving need to begin with problems and tasks to find the questions. Paul and Elder (2006 p. 35) noted that " critical thinking without creativity reduces to mere skepticism and negativity, and creativity without critical thought reduces to mere novelty " The curriculum in UK and Australia train the students to develop their critical thinking and creative thinking to generate knowledge, develop their ideas and concepts, search about possibilities and solve problems. It involves the students to think deeply and develop different skills that can aid them learn and use it at schools or in life. More recently, researchers are finding indications that creativity is more directly related to results and more easily manipulate. (Russo, 1987). Solving problem and critical thinking are abilities to use our experience and knowledge to solve the problems. These skills don't necessary mean that problem will solve in immediate time, it means that the ability to think deeply in order to evaluate the problems and find reasonable solutions in appropriate time.

As mentioned previously, the critical thinking definition by Ennis (1991) “is a reasonable reflective thinking focused on deciding what to believe or do”. It carried a lot of important meanings in critical thinking; most of definitions of critical thinking focused on various skills such as finding relevant knowledge, assessing the information and the questions that find the goals. However, understating the function of critical thinking provide the thinker in logical, reasoning and development environment full with creative people. It to find approaches depending on solving problems by finding different appropriate ways to solve it, identifying the critical thinking process to determine the final decisions, understanding the factors that affect critical thinking, analyze and build appropriate evidence-making guides that make critical thinking more effective in communicating ideas. There are two important types of reasoning, deductive and inductive and to differentiate between the right types to solve problems effectively.

Critical thinking is a process of evaluation or categorization in terms of some previously accepted standards and it is logical examination of data which avoids fallacies and judgments on emotional basis only (Russell, 1960, P.651). Deciding which information is appropriate we need to evaluate it in careful way, it requires the skills such as thinking and analyzing the information to decide and implement the final decision in an integrated way, the skill of evaluation is obtained through its continuous application but some people do not have the appropriate experience to apply the evaluation effectively. There are certain criteria which are important in critical thinking evaluation such as relevant information, logic, depth, clarity and significance. To make important criteria and meaningfulness to the students must be provided in the critical thinking such as guided- discussion to enhance the critical thinking evaluation. It is essential to teach the skills through focused instruction and clear standards of critical thinking skills competency. (Paul & Elder, 2007). The most important way to evaluate skills is to demonstrate a test that enhances decision-making skills, analysis and problem solving. The judgment as a result of poor thinking may be incomplete or biased.

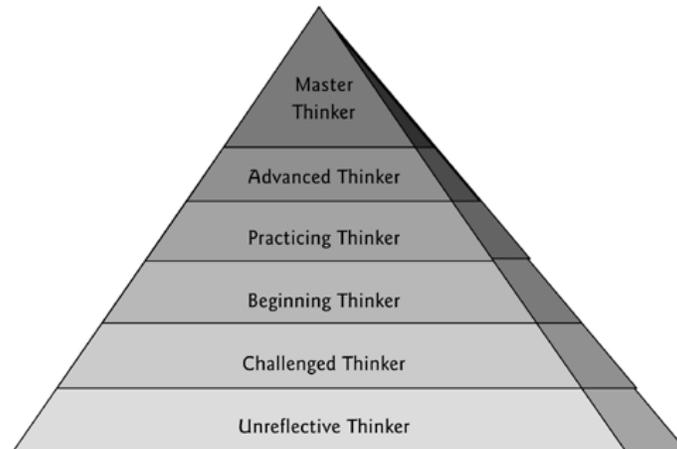
Critical thinking is inquiry, it is abilities to solve problems and make final decisions. The inquiry is a method identified by science teachers to develop their understanding and concepts in

science. Science classroom have many opportunities to use inquiry, Zoller, Ben-Chaim & Ron (2000) suggested that science classroom must move from memorizing concepts and use critical thinking skills instead it does not means using high level of critical thinking.

In addition teaching critical thinking inquiry in science classroom enhanced the students' abilities in different skills such as find problems and different alternative solves, assumptions, evaluate the beliefs and probable results, the steps in inquiry conclude to describe the scientific methods. The equating of the inquiry with the steps of problem solving or the scientific methods, limits the process to identify the problem, gathering and organizing data, analyzing the hypothesis, test the hypothesis, drawing a conclusion, generalizing and finally test the conclusion (Goldmark, 1966).

According to Geertsen (2003), terms such as higher level and reflective has often been confused and used interchangeably with the term critical thinking through literature. The critical thinking stages are divided to the six stages. First, an unreflective thinker is poor in awareness, thinking, identifying problems and assumptions of beliefs. The thinker should develop the basic skills such as compare and conclude to train the brain with basic important skills. Second, a challenged thinker understands the trouble, and is aware about basic concepts, reasoning and criteria to assess critical thinking. They believe about critical thinking skills but they don't know about how to apply it. Third, beginning thinker is aware about elements of critical thinking assessment but they lack system and need to of self-monitoring. Fourth, practicing thinker is tends to understand the critical thinking standards to reach to reasoning. The standards include outcome measure that helps in assessing students and identifying the extents to which they can use critical thinking as a main tool for learning (Elder & Paul 2010). Fifth, advanced thinker understands the problems in deeper levels such as use of critical thinking elements, standards and have sense in evenhanded. Also has the skill to compare and relate between the emotions and needs. Finally, a master thinker or accomplished thinker has established form of important elements in critical thinking such as critique the ideas, deep insight, logic, accuracy, thinking about complex problems, sufficiency and the breadth of ideas. Brennan and Osbourne (2005) suggest that critical thinking is indeed, one of the main outcomes of UK higher education, thought interestingly it is put in inverted commas a reflection, perhaps, of the relative lack of clarity as to exactly what we might

expect that learners will be able to do to prove this. This hierarchical diagram illustrates the levels of thinkers.



2.2.3 Critical Thinking in Teaching and Learning Science

Critical thinking is one of the most important goals in scientific education and identified in teaching and learning as a cognitive skills and disposition. Trilling & Fadel (2009) defined critical thinking as the ability to analyze, interpret, evaluate, summarize, and synthesize information. Students who are skillful in critical thinking are considered to be more capable of understanding the scientific process and become more experimental and better at asking questions on the different aspects of the sciences (Tsai, Chen, Chang, & Chang, 2013). Ability to ask question in science is basic in learning and inquiry. Formulate questions are vital for science learners as it is basis of independent learning and inquiry (Vale, 2013). Critical thinking has a strong relationship previously with the philosophy, pedagogy and other sciences because teaching and learning was traditional and based on content and students memorization. Regardless of its importance, there is a prominent shortage of assent regarding its definition of critical thinking. In addition, the students have long been aware of the importance of critical thinking skills as a result of learning new created combined essence state levels that reflect critical thinking as a multi-disciplinary skill necessary for teachers and students. Critical thinking

as a topic lurks intriguingly behind and about much of the thinking the education (Moon, 2008). Despite common confession of its importance, the teachers should educate their students to explore the ways in which critical thinking has been take in a specific way, investigate, how critical thinking development has been, how students can encourage the development of these skills in their selves and review best skills in evaluating critical thinking. It is essential to teach critical thinking skills through focused instructions and clear standards of critical thinking skills competency (Paul& Elder, 2007).

Science teachers agreed that teaching critical thinking in science education is a big issue and is considered difficult to be a done perfectly and demands continuous learning. The data based is not the only elements to guide in clarification of science. In fact, research findings that to understand students how to learn and raise it. The science teachers try to keep up with new researchers to find the new skills in science education. Science teachers, like all teachers, start each school year with high hopes and anticipations for students to succeed, they are planning their lessons, searching about necessary action equipment, work hard to merge their students inside the classroom. Furthermore, despite good intents and best-position plans, not all students are keen in classes and even fewer obtain control. We see the effect of this all around us, the students' performance on national and global evaluation, comprehensive science evaluation, is poor. In 2012 the PISA survey (Program for International Student Assessment) focused to assess the students in the many subjects such as mathematics, science and problem-solving. The participation in this assessment was 510000 students around the world and their ages range between 15 years and 16 years. The survey in science subject was a test consisted from multiple-choice and questions related to the real-life. The results revealed only 8% of students in science subject can explain, identify the scientific knowledge, understand the scientific methods and apply it in real- life.

In 21st century the new standards in teaching and learning science subject changed the education system, the students are influence through the teachers actions, teaching basic skills and knowledge expectancy to meet the challenges when the teacher teach a scientific subject must be converted in ways that will become familiar and easily interpreted by students to be more flexible in problem solving, cooperation inventive thinking and innovative approach skills they

will need to be successful in work and life. Critical thinking involved the ability of people to can ask appropriate questions to solve problems effectively, and estimate the solutions and processes. The beginning specifically depends on the ability of learners to reason effectively, use planned thinking, make rules and decisions, and solve problems. Traditionally, in teaching and learning science is not incentive in an effective way due to the teachers delivery of the information “teacher-center” and the students memorize the information, suggesting that the students are passive learner. The existing research employs a variety of outcome measures to gauge the effectiveness of teacher preparation, indicating that preparation can have a positive impact on teacher performance (Darling-Hammond, Holtzman, Gatlin, & Heilig 2005; Boyd, Grossman, Lankford, Loeb & Wyckoff, 2008).

Critical thinking is important and necessary in science education but the teachers don't have clear ideas about critical thinking delivery scientific information and critical thinking is rarely used in explicit way. The idea that education has the obligation of teaching people to think and understand how to do so has been intensified throughout time (Baron, 1994). There are several reasons that critical thinking present as an important factor to develop in science education, the first reason, each person thinks about beliefs in a reasonable way, in the other way we must protect ourselves from manipulation, safeguarding themselves from deceivers and exploiters (Boisvert, 1999). The second reason is to be able to individually live in a conscious society. According to the Paul (1993), for the citizens to live, work and function efficiently they need to use critical Thinking abilities to assess, make decisions and judgments with regard to the information they need to obtain, in which they are required to believe and use. The requirements that are important for students to develop the critical thinking in science education are reacting in critical way in a different text, re-write the essay and use critical thinking, build the evidences and develop the critical thinking inside the classroom through the discourse between the students and teacher. Afamasage- Fuata'I (2008) stated that traditional pedagogical techniques, such as lectures and examinations, center on knowledge acquisition, while debates in the technology classroom can effectively facilitate critical thinking.

Critical thinking is described to have an ability of students to acquire in their short-term memory (Forawi, 2016). The science subject is one of the most worthwhile disciplines, it focuses on interpreting the information through inquiry, experiments, seeking about information, support it with evidences, develop the skills that enhance scientific methods, predicting and analyzing the data. It is the most important skill to understand science in a clear way and prepare students to face problems in real life. Encouraging critical thinking in students allows them to become lifelong, independent learners- one of the long- term goals of education (Tsui, 1999). It is an activity that supports the scholastic rigor standards to enhance the academic growth, the students live, responsibilities and careers in future. Enhancing the teachers teaching and learning science subject by critical thinking skills that make the classroom more active and interesting. Whether enrolled in preschool, elementary, middle, or high school, the integration of the skills into the daily content and lessons is essential for achieving this rigor (Tomlinson, 2003). Gelder (2005) claimed that the keys of teaching critical thinking are as follows; the scientific experience of the teacher, the basics and guidelines in teaching critical thinking, the practice of critical thinking skills continuously. The teachers are tested in different ways to measure their effectiveness in teaching and learning. The research must emphasize on the teacher to increase their knowledge, not observing them during the classroom. On the other hand, education is responsible for providing the teacher with the skills and equipment during their career (Hartley, 2010). To develop critical thinking skills, it requires various instructions, practices and time (Halpren, 2014).

2.2.4 Role of Critical Thinking in practical Science

Practical Science (Laboratory skills) is a task for students to observe, ask questions, find assumptions, analyze the data and use materials to find the solutions to evaluate the findings. The practical tasks help the students to be more motivated, develop the scientific methods and the scientific background. The traditional method for teaching and learning science subject depends on content-based and students' memory. However in the last years the critical thinking skills became more important in science curriculum. There is a variety of reasons for addressing nature of science in school science linked to critical thinking (Yacoubain, 2015). The researchers differed to determine the role of critical thinking in teaching and learning practical science. In

addition the critical thinking roles include steps in scientific methods such as observation is important skill and depends on reading, focuses on important points and support the points with evidence, listening and watching is a implicitly and explicitly way which is called the five sense, the observation is the basic of different information and data .

The lack of critical thinking skills is as a result of the students not having enough experience. Enhancing the role of critical thinking in identifying the problems, is important to understand the nature of problems to decisions, find the appropriate solutions and provides the evidences. Formatting the questions which knows as assumptions or hypotheses that helps the students to start obtaining the information and whether to accept or reject the hypothesis. Construction of the knowledge that is related to the nature of relationship between the student-student such as individual reflection or group collaboration, also student-teacher such as class discussion will build the knowledge in positive manner and is more efficient. In this process, students are seekers, searchers, and negotiators of the knowledge; this contributes to the development of their critical thinking skills (Biernacka, 2006; Brown & Ryoo, 2008; Ebenezer & Connor, 1998; Wood, 2012). In general, Critical Thinking is present in process related to the scientific methods or research, such as observation and exploration (Demir, 2015).

Acharya (2016) claimed that activities impact on critical thinking practices on primary science school classroom. The role of practical science to consolidate critical thinking skills through laboratory activities to solve problems and increase the level of students thinking, evaluate the problems and variables through judgment, the questions that effect the problem solving and provide the problem with facts such as what is the problem? , the context to understand the meaning, consider the purpose, describe the facts and be aware about the main ideas, different choices and materials to find alternative solutions, analyzing the information and results are important part in practical science to find the solutions. However, analyzing and draw of the conclusion after the experimenting through measurements into three parts the results stratify with hypothesis, the results partially with hypothesis, the student or teacher try to discover the misunderstood part in the experiment and modify some variables for other accurate results, the results that done stratify totally with hypothesis indicate that the prediction was not accurate, in this case the experiment return and establish new hypothesis and prediction. The final step is

final report that display the hypothesis regardless whether the scientists support the final hypothesis or not.

According to Croner (2003), he evaluated the methods that improve the critical thinking through laboratory activities in science curriculum. In this study by researcher 60 students were involved from middle school in California, data collection was obtained through interview, observation and finally through the examination. The teacher presented a power point to explain the problem solving methods the students perform hand-on activities in groups to follow the problem solving instruction. The researcher was based on Bloom's Taxonomy. The teacher was moving inside the room and making questions that simulate the critical thinking skills. The tasks in the experiments were to identify the problem and involve the questions that make arguments, prediction and make relationship between the knowledge, collect different data, draw the plan or graph to inferences reach to a conclusion. The study illustrates the significant improvement in students' hand-on activity from first lab to the third lab and the half of the students uses their abilities such as critical thinking skills. Most of the students can learn development abilities such as critical thinking skills by themselves. The researchers demonstrate that concept of critical thinking work on to develop different skills such as observation, ask appropriate questions, analyzing, evaluating and self-regulation. Critical thinking is an active and organized mental process that aims to understand the events, situation and thoughts in our surrounding world, as well as our own self, by taking into account our own thoughts and the thoughts of the person with whom we interact (Ozden,2011)

Chapter3: Methodology

In the previous chapters, it is been shown that there are a few studies that illustrated the pre-service teachers' perceptions of critical thinking in science instruction and lesson planning in UAE' schools. This study used a mixed methods approaches; qualitative and quantitative methods. This chapter shows the research design, site, sampling and participants, instruments, science pre-service teachers' questionnaire, validity and reliability of the pre-service teachers' questionnaire, pilot study, science pre-service teachers' interview, lesson plan analysis, data analysis and ethical consideration.

3.1 Research Design

This study took place in three institutes Ajman University, Alain University and College of Technology in Fujairah. Mixed methods approaches used; questionnaires, interview and lesson plan analysis are tools of this study. The pre-service teachers have undergone the training in different schools in the UAE, Public and Private Schools. During their studies in previous years, they taught courses in different curricula such as methods of teaching science.

The general questions to show how the critical thinking skills are important for student to enhance science curriculum, classroom instruction and lesson plan. It focused on some skills such as predicting events, judging, exporting, creatively, analyzing the information and evaluate the information that demonstrate the critical thinking skills. Students need to have a full understanding of some skills such as making a judgment or decision so that they can develop critical thinking skills (Greenberg, 2016).

The survey is an opportunity for teachers and students to contribute to analysis the education policy find appropriate ways for teaching and learning and find solutions to various problems to develop pre-service teachers to follow a new educational policy to develop teaching method. Researchers need to build different studies that help to find appropriate ways to teach different skills in science education. Current studies depend on questionnaires, interviews, observation and intervention of individuals or groups, to find the appropriate approach in education.

The methodology of the study shows the main points as well as the methods of collecting and analyzing the results (Howell, 2013). The term mixed methods works on enhancing qualitative and quantitative data in a one framework (Widson, 2013). Mixed methods are ideal technique to assess complex interventions (Homer, Klatka, Romm, et al., 2008; Nutting, Miller, Crabtree, et al., 2009). The qualitative data does not depend on measuring characteristics of the study but we can get a strong opinion in the study. It focuses on relating or comparing variables or constructs (Creswell, 2014). The table 1 illustrates the methods, instruments and data analysis are used in this study.

S.N	Questions	Instruments	Quantitative /Qualitative	Participants	Data Analysis
1	What are the UAE pre-service teacher's perceptions of critical thinking of science instruction?	Questionnaire	Quantitative	80	Statistical analysis
		Interview	Qualitative	10	Response analysis
		Lesson plan analysis	Qualitative	6	Thematic analysis
2	How do UAE pre-service teacher present critical thinking in science lesson planning?	Lesson plan analysis	Qualitative	6	Thematic analysis
3	What demographic differences, if any, do pre-service teachers' perceptions have regarding critical thinking?	Questionnaire	Quantitative	80	Statistical analysis

Table 1: Study Methods

The researcher used mixed methods to answer the study questions and achieve the research purpose. Therefore, using mixed methods in a philosophical way to produce positive results in a clear way. Measure of the quantitative data “post positivist” is to conduct the quantitative statement and measure of qualitative data “constructivism” is to conduct the qualitative data statements in deeper understanding. The qualitative and quantitative studies are receiving greater attention in recent years and are sometimes described as the naturalistic inquiry, post-positive, constructivist or interpretative approaches (Creswell, 1994). Additionally, pre-service teachers are involved in this study means that the participations play a main role to succeed in the study. This study results depend on the different institutes and using mixed methods that combine both quantitative and qualitative. Crewell, 2014 claimed that the important mixed methods contain from quantitative questions, qualitative questions and mixed methods questions.

This study will be divided in three stages (see figure 1). Firstly, the data collection will be through questionnaires “quantitative method” that will ask pre-service teachers science about their perceptions. Secondly, interview “qualitative methods” that will ask pre-service teachers science about their general ideas in critical thinking skills. Thirdly, lesson plan analysis that include analyzing the activities and sources that are used during the classroom instructions. The

mixed methods will be collected at the same time as well as the data collection should be adequate to answer the study questions and reach to the study purpose.

There are two methods in this study. It includes of both qualitative (open-ended) and quantitative (closed-ended) data to respond the research questions and hypotheses (Creswell, 2014) as well as the questionnaires “quantitative methods” explains more of the research and may help us to reach to the results in a clarify way and discover the importance of critical thinking skills impact on teaching and learning science. The diagram below illustrates the different types of mixed methods approaches along with the stages and their contents.

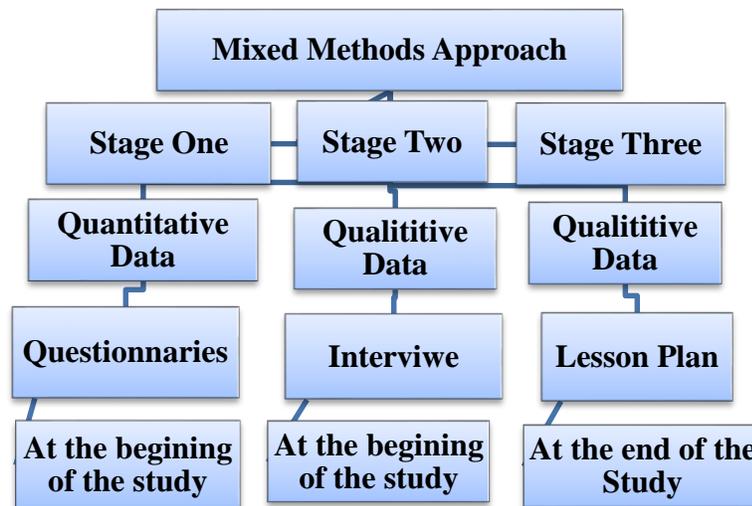


Figure 1: The research design of the study

3.2.1 Site, Sampling and Participates

A total of 80 pre-service teachers were included in this study from three different universities. The size of this population can be determined, and the means of identifying individuals in the population (Creswell, 2004). Firstly, university of the UAE, which is one of highly ranked universities in the UAE in the level of teaching students. The 20 pre-service teachers in Faculty of Education have taken their field training in the various schools in Al Ain city by teaching the British and American curriculum. The pre-service teachers were females, which is about 50% of their students in the Faculty of Education. My study also included 20 pre-service teachers from

Ajman University in two branches Ajman and Fujairah, one of the oldest universities in the UAE as well as the Technical College in Fujairah and Dubai included 40 pre-service teachers whom took the practice in different private and public schools. The UAE has recently been ranked as the best university supported by higher education (Pennington,2017)

The study was a voluntary option for all participations. Pre-service teachers have taken through their studies the courses that are important in field of teaching and learning science as well as courses that enhance development of different skills such as critical thinking skills. The pre-service teachers start their training during 3rd and 4th years of university in three different program primary, middle and secondary school. The faculty members have had an active role to prepare future teachers and incorporating different teaching skills, including critical thinking in science (Forawi, 2012).

3.2.2Instruments

One of the important components of a research design is the instruments that are used to collect the data. Instruments are a tool to measure and test the quantitative and qualitative studies, without instruments the researcher cannot complete the study. The researchers need to do their studies and testing their hypotheses by different instruments but they may lack the knowledge of instruments to be used correctly, serve time and achieve results (Mastel et al, 2016). The researcher developed the questionnaire for pre-service science teachers consisting of questions that target the important skills required to develop the critical thinking skills from their perception. The pre-service science teachers during their study years in university have undergone some courses that include skills of critical thinking as well as they have also applied it in schools in both the British and American curricula.

The first instrument is the questionnaire (see Appendix 3) which measures the skills that enhance the critical thinking during the science classroom such as problem solving, quiet reflection, prediction, judgment and exploring new ideas. It should be put into consideration the beliefs of pre-service teachers in teaching, what they have previously learned in university studies and how

to apply it in general classroom training (Stoughton, 2006). He also supported the pre-service science teachers in critical thinking skills and how to apply them in the future.

The second instrument is the interview (see appendix 4) which is a form of research that relies on asking sequential questions to achieve a certain goal. It consists of three general questions that are related to the study purpose, each question has a purpose that supports the research from a different aspect. The interview is based on responses from the questions for the candidates. There are important steps for the researcher to follow when conducting the interview, first defining the goal, constructing the interviewer's question, conducting and analyzing the interview and finally drawing important conclusions. It was noticed that the teachers answered the first and second questions in a closely related way that made it easier to analyze information.

The third instrument is the lesson plan analysis (see Appendix 5). There is no particular context to be used in the study plan but there are important elements that must be found in each lesson plan (Brown,2001). Important elements that are included in the lesson plan are lesson plan introduction, goals, activities, materials, lesson plan closure, evaluation, teachers' and students' reflection. Woodward (2001) claimed that the lesson plan is not only written, it may be something the teacher does such as writing on the blackboard or reading different sources.

3.2.2.1 Science Pre-Service Teacher Questionnaire

The questionnaire is one of the important tools considered in this study. It consists of a series of questions designed to collect certain information (Mcleod, 2018). The research does not completely succeed without an appropriate questionnaire to explore the study. Generally, there is no basic criteria to follow in order to create questionnaires. It is considered as a written tool, because the candidates answered the questions based on their ideas and the purpose of the study. It's divided into two parts that depend on the objectives; it can be for exploratory purposes to generate specific information or hypothesis as well as designed to test specific information or hypothesis. It's also considered as a tool that sorts the questions into several items such as formulating the sensitive questions that can be placed in the last questionnaire, avoid double questions at the same time that confuses the pre-service teachers as well as avoid emotional statements that will effect on evidence and statistics. However, the questionnaires are determined and deigned based on the study problem. The manner of setting questions in the questionnaire

should be simple and move from one topic to another in a simple and clear way. Furthermore, avoid the incomplete questionnaire that reduces the benefit of it and the respondent feels bored during the answer as well as reduce the error in order to avoid the analysis of information in error. It should encourage respondents to answer accurately (Brancato, et al 2006). The questionnaire includes sections showing personal data such as age, gender, education and other personal questions. The study was applied to a specific sample and it anonymous (McMillan & Schumacher 2010). The questionnaire consists from three important parts of the study. The first part of the questionnaire is closed question “demographic questions”. It is an important aspect of the questionnaire and helps the researcher identify the factors that affect the study from their interest and opinions (Defranzo, 2012). It has advantageous aspects such as ease of answering, clarified questions, easy to compare with another study and less costly to analyze it. (Defranzo, 2014).

Additionally, to collect this information from the science pre-service teachers will be according to age, gender, courses they have given during their academic years, years of training in the schools. The second part of the questionnaire is concerned with the perceptions of science pre-service teachers that show important strategies in teaching critical thinking skills through their training in schools. The questionnaire was based on the Likert measurement, which is strongly agreed, agreed, I do not know, disagree and disagree strongly. Likert Scales is the best measurements that can be relied on to measure different individuals’ opinions, concepts and behaviors. Rensis Likert was an American psychologist (Johns, 2010). The scale in this questionnaire aimed to make the pre-service teachers completely relaxed during answering in explicitly and clearly way. The 21 questions in questionnaire demonstrate statements that relate to the study purpose in critical thinking skill as well as indicating to the frequency and percentage of responses as well as designed for pre-service science teachers to gather information by questions that demonstrate their perceptions related to critical thinking skills, which might support the learning strategies, and students’ learning in science classes.

3.2.2.1.1 Validity and Reliability of the Pre-Service Teacher's Questionnaire

The questionnaire is kind of tool that facilitate the prediction process and data analysis as well as contribute to measurements and surveys (Brancato, et al 2006). The importance of a research is to the measure validity and reliability (Bolarinwa, 2015). Validity is a measurement of the items on study that wanted to be measured as well as the reliability is a degree that can repeat the results by measurements (Bolarinwa, 2015) .All the tools in this study were revised before submitting to pre-service science teachers, it was provided with questions that reach to the study purposes. Final modifications were added to the questionnaire such as important elements that will help the science pre-service teachers to answer the questionnaire questions. Validity and reliability does not carry the same meaning in qualitative and quantitative researches because each depends on a particular method and is not generalized (Creswell, 2014). There are several questions in the study research validity that raise many responsibilities, including whether the intervening factor affects the search result (Creswell, 2014). The rational increases according to the validity and reliability of the results (Creswell, 2009). The type of validity used in this is content validity. It is more accurate and based on statistics; the researcher must choose the questions that are aimed to obtain the answers of the objectives of the study (Stephanie, 2015).

This questionnaire was conducted during the second semester of academic year due to most of the science pre-service teachers do their training in second the semester. The questionnaire was distributed directly to the science pre-service teachers to collect qualitative and quantitative studies in terms of perceptions of critical thinking skills in science. A specific time has been set and communication has been repeated to try to complete the questionnaires to increase the number of questionnaires to a maximum. The expert from college of education checks the questionnaire questions from assessment department to provide the content with validity.

The data collection used multiple processes and methods used in the study to provide opportunities for results from multiple aspects (Çalışkan, 2014). Reliability and validity are significant components of the quality of quantitative research method (Ling el at, 2008). The anxiety part in the research does not change based on the demographic questions such as gender, ages or university program as well as is based on Reliability and validity part (Tosun, 2014). Can be considered Qualitative data plays important roles to increase the validity and reliability to

quantitative methods (Fraenkel & Wallen 2012). There is a different between the validity and reliability in qualitative methods, the validity means find the data accuracy and the reliability means the results are consistent across of different researches and projects (Gibbs, 2007& Creswell, 2014).

3.2.2.1.1.2 Pilot Study

Pilot study is a simple study before the whole study is done in the project to test the important aspects in the research design, data collection, instruments to be modified before the final commitment to modification as well as to improve the quality and efficiency known in quantitative research. Research strategies need accuracy and pilot study is a part of the research strategies. The questionnaire has to be examined with internal and external validity as well as the evidence to control the incorrect situations. Internal validity is observing the variables and demonstrates the correlation between the different variables as well as to improve the strange variables (Mcleod, 2013). All of science pre-service teachers have experience as well as the same factors. External validity is generalizing the results of the study could be used in other places and times. In addition, it's divided into approaches; sampling model and similarity model (Trochim, 2006). Sampling model is to identify the sample that will be studied from the community and conduct its research as well as the similarity model is approach means that people are more similar to people or at least similar among people and depends on places and contexts. The similarities can be studied under the generalization (Trochim, 2006). The instruments that used in the study not changed as well as the study convenient for pre-service teachers. The researcher chose 24 questionnaires out of 80 to test the reliability, if reliability results is >0.7 the level of internal consistency of the questions in the questionnaire is considered good. Since Cronbach's Alpha = 0.888, which is greater than 0.7, this indicates the consistency of the 21 questions in the questionnaire of the study is considered good.

3.2.2.2 Science Pre-Service Teacher Interview

The qualitative questions “open-ended questions” was interview which is a second tool that supported the study to clarify and confirm the information. It consists from three questions; it helped to find answers to the research objective more broadly. The interview information is more

accurate than the questionnaire information to explain the questions and clarify the requirements (Qaseem, 2011). The pre-service teachers answered three questions were asked for to demonstrate the qualitative method which is open-ended questions that to give a chance to provide the pre-service teachers their different opinions to explore the perceptions. It is also explains the strengths and weaknesses of the research purposes. An open-ended question in an interview makes it easier for the researcher to find answers and analyze them easily. They help in exploring a lot of previous experiences and beliefs of interviewees (Chadwick, 2008). The pre-service teachers were interviewed with the same questions in the questionnaire. Most of the teachers answered the questions enthusiastically whereas some have only completed the questionnaire.

The researcher developed the interview questions for pre-service science teachers in order to achieve the study purpose. Questions were generally put based on the term critical thinking skills to find answers from their perspective. The questions were simply formulated as many pre-service teachers may feel bored during the interview. However, upon comparison between the questionnaire and interviews, interviews make the research more profound in the opinions of others (Kvale, 1996; 2003). During the interview, pre-service science teachers were asked questions and their answers were written down on paper to be easily analyzed. The last question in the interview was very general, most of the pre-service teachers did not answer it directly as they were more enthusiastic to answer the first and second questions.

3.2.2.3 Lesson Plan Analysis

The teacher in the classroom uses their experience to coordinate the lesson plan as well as analyzing the methods and tools that are used in the lesson plan aimed to support the educational process to improve (Samson, 2016). The third tool in this study used is analyzing the lesson plan, this step made the researcher involve many tools to find accurate information. The researcher developed the lesson plan analysis protocol (see Appendix 4). A lesson plan is a guideline, the teachers describe what the students will accomplish, the goals they will achieve during the lesson, the types of activities they will practice and the materials used inside the class room (Cox, 2018). Pre-service teachers use an organized and coordinated lesson plan to facilitate

the process of teaching and learning science curriculum to communicate lesson plan goals and make it easy to the students. The lesson plan contributes to improve the goals and the process of analysis in the future, the methods and tools aimed to support the educational process. Planning instruction means establishing priorities, goals and objectives for students, the goals are statement of intent but the objective are achieved goals for both students and teachers (Donald, et al, 2013). The important goals of lesson planning are all the activities supported by the educational system.

There are many materials that support the teaching and learning methods to the students to acquire new concepts in different dominos. To provide an effective learning environment, the teacher should plan effective lesson plans (Clark & Dunn 1991, Johnson, 2000; Rusznyak & Walton, 2011). In addition, the lesson plan is different from primary level to other levels and the lesson plan should be effective in the class room because it is a framework to work. The lesson plan may take days to complete the goals. Pre-service teachers have found planning for lesson difficult to work out because their experiences are lacked in this field (Tashevskaa, 2008). Pre-service teachers have been involved in training programs to demonstrate the importance of lesson planning and to plan their lessons effectively in teaching and learning science curriculum. It helped the science pre-service teachers to fill the gaps in science education between theory and practice as well as most of them continues to teach in a traditional way, despite the development of modern methods of teaching and learning science (Taskin,2017).

McCutcheon (1980) claimed the reasons that build the lesson plan are divided into; internal and external reasons. The internal reasons for pre-service teachers such as feeling confident, which will in turn develop the students' confidence in themselves as well as run the classroom more smoothly. The external reasons are following the school principal requirements in the fullest way. The pre-service teachers identified that lesson plan organizes the curriculum content. (Taskin, 2017). It also helps enable to teach, learn and evaluate the level of their students thinking. Moreover, involving the pre-service teachers to organized and create lesson plan will increase the experience in teaching and learning science education as well as develop the evaluation of interaction between the students.(Urata & Pothen, 2011). Many factors influence on lesson plan such as classroom management and time (Sari, 2013).

The teaching of critical thinking skills is important and necessary for students and every pre-service and in service teachers who are looking for the best way to integrate it during the classroom. The questions may be asked, including what are the best strategies for teaching critical thinking skills to the students?. The term of critical thinking skills in lesson plan are used to formulate your thinking a clear and independent perspective, write your own opinions and also accept other perspectives. Many teachers fail to identify the critical thinking concepts in the lesson plan (Paul, 1995). In most countries, the skills of critical thinking are not a basic requirement in science curriculum and pre-service teachers lack advanced preparation programs. (Ewie,2010). In addition, they lack clear ideas of the relationship between the basic skills and general skills of critical thinking concepts.

In this study, science lesson plans from different program in school (see Appendix 5) has been chosen. The goals and content has been analyzed on the important aspects in lesson plan. The lesson plan mentioned the objectives that the students should achieve at the end and the goals were structured from the student's background to build new knowledge and concepts. The pre-service teacher provides the lesson with same materials to help students to achieve their goals. The information in lesson plan was adequate to describe the goals. The students used familiar tools in the experiment and their ways to deliver the knowledge was acceptable. Furthermore, the lesson plans showed that the environment was organized, it is important that the lesson plan should be more safe and comfortable during the classroom. The experiment used safety tools as mentioned in lesson plan. At the end of lesson plans, the pre-service teachers used a general discussion that encourage good environment to the students.

The time was one hour for each lesson plan, it is enough to determine and achieve all the lesson aims, and the pre-service teacher divided the time equally between the lessons' parts. They used some of the time to share the video with students to introduce the lesson as well as the technology is a very significant part in the lesson plan especially in recent years as well as the pre-service teacher starts with a traditional way to introduce the lesson explanation, the students are just listing "passive" after that the pre-service teacher moved to hand-work directly with out give a student's questions to introduce the experiment and leave them to explore the materials by themselves. The lesson plans consisted of clear content that described the different objectives as

well as instruments that helped to achieve the lesson plan goals and the evaluations that contributed in their achievement.

3.4 Data Analysis

The quantitative data was collected through distribution of the questionnaire consisting of 21 questions that target important skills. The data was collected from 80 pre-service science teachers whom have undergone their training in different private and public schools. The quantitative data is analyzed by SPSS program to find the results. The score of the mean and standard deviation of all questions in the questionnaire were analyzed and showed that all the candidates include in the study were at a similar level of perception.

The qualitative data was collected through interviews and lesson plan analysis. The interview consisted of three important questions as well as six lesson plans to find accurate information that support the study questions. The first question of the study, which was the pre-service science teachers' perception (independent variables) of critical thinking skills of science instruction (dependent variables), the results of the mean and standard deviation of all questions were calculated to find the results. The second question of this study was whether the pre-service teachers present the critical thinking skills (independent variables) in science lesson plan (independent variables) or not. The third question in this research was whether the year studied in the university or level of teaching (independent variables) had an effect on pre-service teachers' performance (dependent variables), the data was analyzed used t-test to study the demographic factors for both years studied in the university or the level of teaching.

In addition, other variables in this study may affect the outcome and may help us find the common and different variables and their effect on the outcome of the study. The Cronbach's Alpha was calculated to find the consistency of 21 questions in the questionnaire of the study.

3.5 Ethical Considerations

The most important issues to be considered by the researcher are the ethical issues. It is the rules and behaviors that determine the difference between acceptable and unacceptable behavior as well as is important and essential in any research conducted on individuals or society (Creswell, 2013). All kinds of research, the researcher must consider the important principles in the mixed research because they combine between quantitative and qualitative study. The letter was sent from British University in Dubai (Appendix 1) to the UAE University in Al Ain, Ajman University and the Technical College in Fujairah to obtain a permission to conduct the study, information collected by the above institutions must be kept confidential and the identity of the volunteer participants in the study is maintained confidential as well. Moreover, science pre-service teachers “the voluntary participants” will be informed about the most important aspects on which the questionnaire was based in order to achieve the objectives better. Ethical issue focuses on important principles that are based on human rights and compliance with law as well as standard of health. United Arab Emirates University has examined the questionnaire under a social sciences research ethics committee to confirm that the questionnaires questions and interview questions are achieved the conditions of ethics issues (Appendix 2).

Moral obligation to complete a research project is planned well for research. In addition, Bryman and Bell (2007) claimed that there are important points in ethical consideration; ensure full consent for voluntary participation, ensure the privacy of the participants was maintained and their identities were kept secret, avoid overstating your search goals and avoid misleading information that can effect on search results.

Chapter 4: Results and Data Analysis

The main purpose of this study was to investigate pre-service teacher’s perceptions about critical thinking in science instruction and lesson planning in UAE’s schools. This chapter presents the results of the study of both qualitative and quantitative methods and examines the pre-service teachers’ perceptions about critical thinking skills as well as their response in open-ended

questions. Furthermore, the lesson plan analysis is to determine how critical thinking skills are applied in lesson plan is.

4.1 Demographic Information

The purpose of this questionnaire is to measure the perception of participating pre-service teachers who have been trained in different schools in the UAE (N=80) about critical thinking in science instruction. The table 3 in the next page shows the results of demographic information which includes years of university, the grade level at which it was taught by the pre-service teacher and critical thinking course taken during the university year. The participants were 80 female science pre-service teachers whom did their training in different schools in the UAE as well as taught the American and British science curriculums.

As shown in table 3, the third year number of pre-service teachers is 28, which comprises 35% from the total sample as well as fourth year of pre-service teachers are the largest number in the sample 35, which comprises 43.8% from the total sample. The numbers of students from the second year are low because of the fact that not all of them do their training in schools and are considered one of the early years in the university and represent their number 17 students, which are 21.2% from the total sample. The pre-service teachers were distributed to different schools. In this study, 81.2 % of them were taught at the primary level where as 18.1 % of them were taught in middle level. The last two rows described the number of pre-service teachers that have been taken course of critical thinking; most of them took the courses of critical thinking skills from third and fourth years, which was around 80% from the sample. The third and the fourth years of the Faculty of Education in the science field in the universities is one of the important years which provides them with advanced courses that enhance the development skills that can be taught such as critical thinking skills.

Year	Number	Percentage
Second year	17	21.2%
Third year	28	35%
Fourth year	35	43.8%
Level	Number	Percentage
Elementary	65	81.2%
Middle	15	18.8%
Course of CT	Yes	Percentage
Yes	64	80%
No	16	20%

Table2: Percentage of Pre-service Teachers' Demographic Information

4.1.1 Science Pre-service Teachers' Perceptions of Critical Thinking skills based on Years of University and level

In the table below, the two rows are achieved from pre-service teachers' questionnaire. Means and standard deviations for each year of university and level were reported. t- Test values with associated p-values were reported indicating that there were no statistically significant difference between pre-service teachers into different year studied in the university and level of teaching as well as p-values exceeded 0.05.

As shown in the table 4, there is no important difference between the pre-service teachers in third year (M=4,.9,SD=0.40) and fourth year (M= 4,05,SD=0.50) as that no significant difference between second year (M=4.03,SD=0.38) and third year (M=4,.9,SD=0.40) . There is no significance in grade level was taught by pre-service teacher, elementary level (M=4.6, SD=0.45) and Middle level (M=4.07, SD=0.41). These results indicated that science pre-service teachers had a same level in the years of university.

Question	Mean	Std. Deviation	Test Statistics	Interpretation
Year	Second = 4.03	0.38	Own-way ANOVA F= 0.147 P-value = 0.864	There is no significant difference between pre-service teachers into different year studied in the university.
	Third = 4.09	0.40		
	Fourth = 4.05	0.50		
Level	Elementary = 4.06	0.45	Independent T-test T = -0.081 P-value = 0.936	There is no significant difference between pre-service teachers into different level of teaching.
	Middle = 4.07	0.41		

Table3: Science Pre-service Teachers' Perceptions of Critical Thinking Skills Based on Years of University and Grade Level

4.2 Pre-service Teachers' Perceptions of Critical Thinking Skills

The first tool is used in this study to investigate pre-service teacher's perceptions about critical thinking from their point of view as well as effect on the learning process during the science classroom. This study is a comparison between the impacts on teaching science based on advanced skills (independent variable) and impacts on the skills of critical thinking to the students (dependent variable) as well as variables results on years of university, grade level and pre-service teachers' background of critical thinking skills (dependent variable).

4.2.1 Pre-service Teachers' Perceptions about the Effects of critical thinking skills on teaching Instructions

In the table5 in the next page, shows the percentage of science pre-service teachers' whom answered the questions in the questionnaire. Most of them provided the answers in likert scale ranged between agree and strongly agree, which means the pre-service teachers have a similar level of perception about the effect of critical thinking skills on teaching instruction. I noticed that most of them answered the first question by "agree", which is around 30% of them. This means that most of them do not have a background that the skills of critical thinking in science teaching are greatly based on the investigation and this percentage does not mean that they have a simple background in teaching critical thinking in science curriculum.

Most of the pre-service teachers' responses are convergent in all the questions. This means that the perceptions of the impact of teaching critical thinking in science curriculum are similar as well as I noticed that a few of the teachers responded disagree or strongly disagree. This means that pre-service teachers have a clear background in critical thinking skills in teaching instructions. Some of the questions explained the ways of teaching critical thinking skills in science curriculum such as ask open-ended question, discussion between the students and teachers, quite reflection and exploration of the students' ideas during the lesson. Their responses

in these questions ranged between agree and strongly agree, which means the pre-service teachers following the same level of methods of teaching critical thinking skills. Furthermore, most of the questions in the questionnaire are to demonstrate the development skills that affect teaching science instruction during the classroom. Their answers were positive and this means these skills have a significant impact to develop critical thinking skills.

Question	Agree		Strongly agree		Mean	SD
	#	%	#	%		
Questions						
1.Critical thinking focuses on investigation	24	30%	10	12.5%	3.53	0.75
2.Critical thinking encourages open-ended questions	53	66.3%	21	26.3%	4.14	0.69
3.Critical thinking makes classroom environment attractive for learning	51	63.7%	24	30%	4.21	0.65
4.Critical thinking generates curiosity between the students	42	52.5%	28	35%	4.21	0.69
5.Critical thinking gives importance to discussion, debate and discourse	48	60%	29	36.3%	4.31	0.59
6.Critical thinking prepares the students to communicate with real world problem solving	51	63.7%	19	23.8%	4.10	0.63
7.Critical thinking allows the students to make connections and see relationships	54	67.5%	17	21.3%	4.09	0.60
8.Critical thinking allows for quiet reflection	36	45%	11	13.8%	3.69	0.76
9.Critical thinking makes the students predict events	45	56.3%	20	25%	4.05	0.69
10.Critical thinking allows all students to involve in learning	33	41.3%	17	21.3%	3.79	0.84

11.Critical thinking helps the students to develop standards to make informed judgments	47	58.8%	17	21.3%	3.99	0.72
12.Critical thinking helps the students' value different ways of working.	51	63.7%	16	20%	4.03	0.64
13.Critical thinking gives opportunities to explore ideas, keep options open and imagine what might be.	53	66.3%	21	26.3%	4.17	0.59
14.Critical thinking develops a balance of thinking	48	60%	24	30%	4.20	0.60
15.Critical thinking makes the students more creative	51	63.7%	24	30%	4.23	0.60
16.Critical thinking makes the students analyze the information	54	67.5%	21	26.3%	4.19	0.58
17.Critical thinking makes the students evaluate the information	56	70%	18	22.5%	4.14	0.57
18.thinking makes the students look for evidence	45	56.3%	20	25%	4.05	0.69
19.Critical thinking makes students take Decision in different situations	42	52.5%	18	22.5%	3.96	0.72
20.Critical thinking makes the students more checking with new information	52	65%	16	20%	4.04	0.63
21.Critical thinking stimulates collaborative education	53	66.3%	20	25%	4.13	0.66

Table4: Percentage of Science Pre-service Teachers' questionnaire

4.2.1.1 The Effects of Critical Thinking Skills on Pre-service Teachers' Way of Teaching

The second part of the questionnaire contrives the perception of all science pre-service teachers from different universities. The table 6 presents the pre-service teachers' response about the

effect of teaching critical thinking skills during the class room. The highest three means is makes generates curiosity between the students (4.31), critical thinking makes the students more creative (4.23) and classroom environment attractive for learning and gives important for discussion (4.21). As reflected in the questionnaire, the three lowest mean is for critical thinking focuses on investigation (3.53), it allows for quiet question (3.69) and it makes the students predict the events (4.05). The following table shows the means and standard deviations of pre-service teachers' response of way of effect teaching critical thinking skills during the classroom.

Question	Descriptive analysis		
	N	Mean	SD
1.Critical thinking focuses on investigation	80	3.53	0.75
2.Critical thinking encourages open-ended questions	80	4.14	0.69
3.Critical thinking makes classroom environment attractive for learning	80	4.21	0.65
4.Critical thinking generates curiosity between the students	80	4.21	0.69
5.Critical thinking gives importance to discussion, debate and discourse	80	4.31	0.59
6.Critical thinking prepares the students to communicate with real world problem solving	80	4.10	0.63
7.Critical thinking allows the students to make connections and see relationships	80	4.09	0.60
8.Critical thinking allows for quiet reflection	80	3.69	0.76
9.Critical thinking makes the students predict events	80	4.05	0.69
10.Critical thinking allows ail students to involve in learning	80	3.79	0.84
11.Critical thinking helps the students to develop standards to make informed judgments	80	3.99	0.72

12.Critical thinking helps the students’ value different ways of working.	80	4.03	0.64
13.Critical thinking gives opportunities to explore ideas, keep options open and imagine what might be.	80	4.17	0.59
14.Critical thinking develops a balance of thinking	80	4.20	0.60
15.Critical thinking makes the students more creative	80	4.23	0.60
16.Critical thinking makes the students analyze the information	80	4.19	0.58
17.Critical thinking makes the students evaluate the information	80	4.14	0.57
18.thinking makes the students look for evidence	80	4.05	0.69
19.Critical thinking makes students take Decision in different situations	80	3.96	0.72
20.Critical thinking makes the students more checking with new information	80	4.04	0.63
21.Critical thinking stimulates collaborative education	80	4.13	0.66

Table5: The Effects of Critical Thinking Skills on Pre-service Teachers’ way of teaching

4.2.2Pre-service Teachers’ Responses to the Qualitative Data “Interview”

During the questionnaire distribution to science pre-service teachers, I got an opportunity to interview the teachers with three questions to collect additional information to support quantitative data as well as to support the study purposes. Most of the science pre-service teachers answered all the questions in clear and concise words.

1- What critical thinking means?

- “It is a way of thinking that goes through some stages as well as it allows the thinker to come up with creative ideas and solving problem.”
- “It means to analyze and evaluate some issues and makes a judgment.
- “It is ability to think and understand the logical ideas or what to believe”
- “It means people conclude information based on facts and evidence.
- “It is the ability to analyze information in an unusual way and be logical and profound “
- It is means Critical thinking skills are to expand students' perceptions and build their investigative skills, problem solving and creative thinking
- It is one of the 21st skills that students need to develop in order to improve their understanding of the content, and to improve their outcomes. Also, it needs collaboration between students, students and teacher and to engage it with other skills to develop it. All students should be prepared properly and they have to improve their critical thinking to achieve the required skills for the higher education and career path.

2- Why do students need to develop critical thinking skills?

- “To enhance their academic performance, to learn thinking independently and to be ready to face the future challenges that may counter them in the work place”
- “To help them to deal with their problem”
- “To help the students to use their information that will encourage the students do their analysis the information and thinking assessment.”
- “The students need critical thinking to be more creative in their performance and learn how to be flexible during thinking for any issue they might have.”
- “Critical thinking skills help the students to present their thoughts in an organized and persuasive manner.”
- “Critical thinking skills encourage the students to share their thinking with others”

- “It helps the students to solve problems in different solutions, perspectives as well as improves communication between teacher and students.”
- “To increase their cognitive understanding. As well, to be qualified for higher education and careers such as : STEM fields”
- “It contribute to building their awareness, self-confidence and curiosity”
- “It develops the students in future careers”

4-How do you personally use critical thinking skills in daily life, tutoring and school?

- “ I used it to listen to the students’ personal experience and to start gathering information as well as I apply it in the classroom to encourage the students to ask questions rather than ask them “Student-center”
- “I used it to think of the students’ issue and how can I solve it with 21- century skills.”
- “Give the students different topics or questions that will use their critical thinking such as open-ended questions or investigation about things”
- “I used it to open the discussion, share information to find good results and knowledge”

4.2.3 Pre-service Teachers’ Present Critical thinking skills During the Lesson Plan.

To support this research purposes in different aspects and to understand how the pre-service teachers present critical thinking skills during the lesson plan. This study included six lesson plans analyzed for the pre-service teachers with different academic years in university, in both primary and middle schools. Table 8 below, shows the lesson plan analysis (see Appendix 5 and Appendix 6) and was presented during the pre-services teachers’ classroom.

Lesson plan elements	Data Analysis
Lesson plan Objectives	<ul style="list-style-type: none"> - Consist of 1-2 Clear objectives - Appropriate for students’ level - Brief and enjoyable - Attracts students' attention

Lesson plan Introduction and Activities	<ul style="list-style-type: none"> - Introduce the instruction - Asking different challenging critical thinking questions. - Division of students into groups - Monitoring the students during their work. - Encouragement of the students in problem solving - Linking between real life and class room environment - Introducing main concepts related to the lesson plan - Integrating the technology during the lesson plan - Supporting the students with activity tools
Lesson plan Materials	<ul style="list-style-type: none"> - Simulate the lesson plan - Simple materials - Develop critical thinking skills - Make students more curious
Lesson plan Evaluation	<p>the teachers evaluate the students through different ways such as:</p> <ul style="list-style-type: none"> -Discussion between the teacher and students. -open-ended questions. -Home work. -Project. -Writing summary. -Asking students' about their perceptions. -Discussing the experiments' results.
Lesson plan Closure	<p>Most of the teacher close the lesson plan by:</p> <ul style="list-style-type: none"> -Present the main lesson plan' concepts. -Re-cap the lesson plan objectives. <p>Most study plans were lacking closures due to lack of time</p>
Pre-service Teachers' and Students' Reflection	<p>Most study plans were lacking reflection due to lack of time as well as most of them depended on the evaluations at the end of each lesson plan.</p>

Table 6: Lesson plan analysis

4.3 Summary of Results

The information obtained from the previous tables concludes that the relationship between pre-service teachers' teaching critical thinking skills during classroom are interrelated with students' learning critical thinking skills. The questionnaire was clearly answered by pre-service science teachers that the ways of teaching critical thinking motivate the student to develop skills such as

evaluate their information, explore new ideas, collaborative learning and balance of thinking that enhance critical thinking skills. The results indicated that science pre-service teachers have the same level of teaching critical thinking skills and there is no significant difference between different year studied in the university and level of teaching in the schools.

Furthermore, lesson plan analysis supports this study and presents how the pre-service teachers present their strategies of teaching critical thinking skills to the students as well as apply it on students learning in a positive manner.

In the next chapter, I will discuss the results and make recommendation that improve science pre-service teacher perception of critical thinking of science instruction and lesson planning in UAE schools as well as I will discuss the limitations of this study.

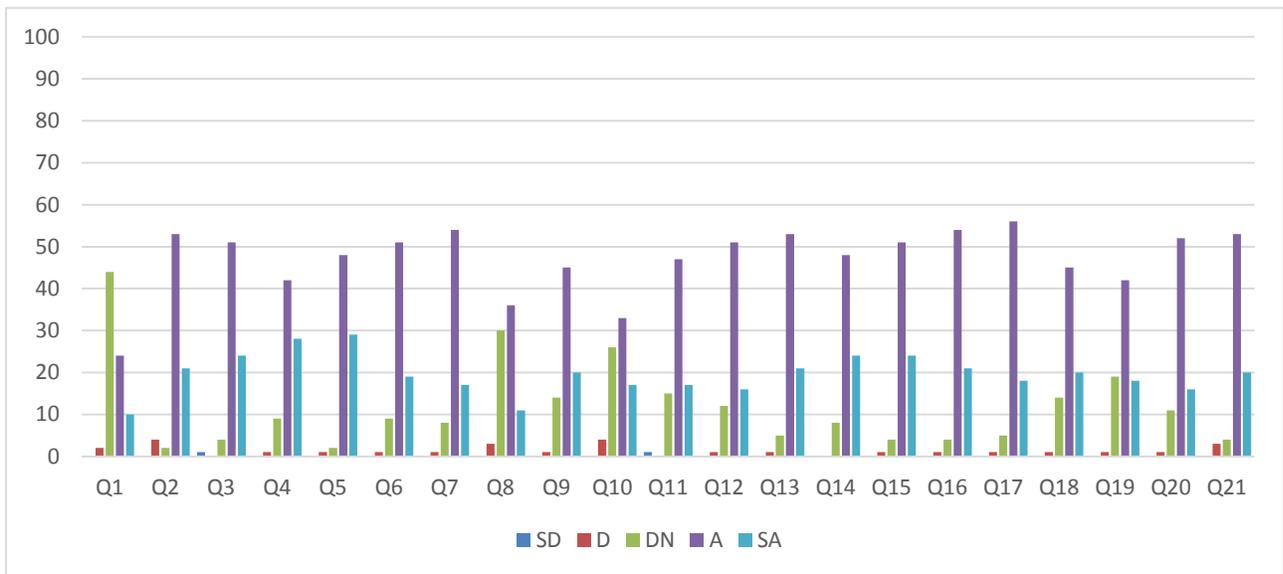


Figure 2: The mean and standard deviation of all questions in the questionnaire

Chapter 5: Discussion and Conclusions

Critical thinking skills became a catchphrase to many pre-service and in-service teachers. It enhances the classroom culture as well as helps the students to develop, acquire new skills and

concepts in science curriculum. This chapter discusses the findings of this study, conclusion, and limitations, recommendations for the field and for future researches.

5.1 Discussion

Nowadays the researches are focusing on pre-service teachers' quality such as paper searches about activity of pre-service teachers as well as paying attention to their level of critical thinking. The basic beliefs about critical thinking are how the teacher interacts and prepares for basic skills during the classroom (Fang, 1996, Putman & Borko, 2005). The purpose of this study was to investigate pre-service teachers' perceptions of critical thinking in science instruction and lesson planning in UAE' schools, which is implemented through mixed methods; qualitative and quantitative methods on science pre-service teachers from different universities. Accordingly, questionnaire, interview and lesson plan analyses were adopted to answer the study questions.

The first question in this study was to investigate the perceptions of pre-service teachers in critical thinking skills that affect science instruction; the results indicated that pre-service teachers who answered the questions got high mean in their answers. The pre-service teachers have approximately the same level of perception about the effect of critical thinking skills on teaching instruction. Many previous studies examined the pre-service teachers' perceptions of critical thinking skills as well as agreed with these results. In addition, many studies have discussed the importance of the development of critical thinking skills and its impact on education in important way and unquestioned goal (Stančić & Radulović 2017). Many universities' teachers claimed that the education students do not have a high level of critical thinking due to the nature of education courses which do not contribute to develop it (Stančić & Radulović 2017). Methods of teaching science developed and included several aspects such as investigation, problem solving, scientific experiments, discussion and cooperative learning methods. As well, the science curriculum that begins at the primary level is important for the students in the future career (Bohn, 2017).

In 2008, Paul and Elder claimed that in order to raise the level of critical thinking, primarily must raise the level of formulated questions in a clear way, raise the level collecting relevant information, think open-mindedly, communicate effectively with other people to find different solution in complex problems and come to a conclusion testing the relevant standards. The

debate is an important way to engage students in learning science and dealing with different science issues and also may help them to link between daily lives and achieve the objectives of the science curriculum. Students should choose the most important ideas that suit the debate motion and define their problems (Iman, 2017). The new science curriculums have adopted a new approach based on reflective thinking and should be promoted by the pre-service teachers (Gencer, 2008; Kilinc, 2010; Toman & Cimer, 2014). The science curriculum provide the students with knowledge regarding new concepts. The collaborative work is essential to develop critical thinking skills as well as to consider the kinds of classroom and school cultural (Allamnakhrah, 2013). The successful teachers can involve multitasks per day such as organization, analysis, decision making and verbal instruction (Stangic & Radulvic, 2017). In this study, I found that the science pre-service teachers are interested in including critical thinking skills during the science classroom to enhance their science instruction as well as to improve the level of thinking to their students.

The pre-service teachers' perception of learning critical thinking is still evolving, especially in Gulf States (Allamnakhrah, 2013). Most of the science pre-service teachers considered that the term of critical thinking skills is modern in education system (Stancic & Radulovic, 2017). The UAE education has undergone a great deal of progress since 2007 through courses and subjects, including science as well as the pre-service teachers become more aware about the development of the skills that enhance the educational system. Science curriculum has been traditionally taught in the past "teacher-center" but nowadays it has been based on different skills such as inquiry-based and investigating for effective learning (Kadbey & Dickson, 2014). The new science curriculum introduced critical thinking skills rather than teaching in traditional way "teacher-center". In 2017, Stangic and Radulvic considered that understanding critical thinking skills is related to three things; individual cognitive abilities, objectives of instructions and appropriate cognitive program. Other studies confirmed that teaching critical thinking skills is cultivated by teaching model of problem-solving and critical thinking skills (Staey D, et al 2003).

To answer the second question, the pre-service teacher presents critical thinking in their science lesson plans in a clear way but they lack the integration of critical thinking skills in an exciting way. The essential idea in lesson plan is to redesign the strategies of teaching and learning critical thinking skills in a simple way (Paul et al, 1987). Science pre-service teachers should

have important approaches that facilitate the integration of critical thinking skills in science lesson plans for example, the ideal approach to highlighting critical thinking skills in science classroom, the science pre-service teacher start to divide the students in two groups to discuss particular subject and use phrases such as “I” when they express their ideas(Crockett,2016). They may use the method of reading in silence; at the end of the lesson the teacher asks a question about a particular issue that will have multiple perspectives (Chiliberti, 2018). A critical thinking skill occurs when the students try to make judgments with relevant criteria (critical thinking consortium, 2015).

In a previous study done for lesson planning on grade 6 and the role of development of critical thinking it has been concluded that the integration of critical thinking skills have changed the study plan as well as had a great impact on the development of critical thinking skills upon students (Poonpipathana et al, 2014). Activities that enhance critical thinking skills must be based on student levels, for example, activities that enhance critical thinking skills at the primary level, classification the things and set of rules. Classification plays an essential role in critical thinking in primary level (Cox, 2017). A middle school level enhances critical thinking skills through experimental investigation (critical thinking consortium, 2015). The contents of the science curriculum have a significant role in enhancing critical thinking skills. There are examples of some curriculum in several countries designed for two purposes to show a clear understanding of critical thinking concepts and how to teach critical thinking skills in lesson plans. Ail Students' of thinking as well as poor achievement in critical thinking skills due to absence of “student-centered” learning strategies. Science pre-service and in-service teachers are required to encourage their students to build knowledge as well as thinking by asking open and end-to-end questions that are relevant to the content, providing opportunities to link past information with current ones and introduce challenging activities. Students will be motivated when the teaching and learning basis of the content are meaningful enough to achieve the goals such as learning activities based on reflection inquiry and intellectual development (Kopzhassarova et al,2016).

To answer the third question in this study, do pre-service teachers' perceptions have demographic differences regarding critical thinking? Cimer et al (2014) found that, training tends to help science pre-service teachers to raise their experience before real education

environment. However, the appropriate training use strategies to develop higher-order thinking. The critical thinking terms is not only deficient in developing countries but also in most pre-service and in service teachers in UK (Allamnakhrah, 2013). The new generation needs to increase and improve critical thinking skills to benefit from it in the future as well as to allow pre-service teachers to improve themselves in terms of critical thinking (Akgun& Duruk, 2016). In another study, it was demonstrated that the lack of development skills in pre-service teachers was due to the in-service teachers responsible for training pre-service teachers didn't hold a professional teaching qualification in pedagogical background (Barber et al, 2007, Ridge, 2010). The most concern for pre-service teachers is the outcome of critical thinking (Allamnakhrah, 2013). Irez (2006) found that the teachers in general, should improve their perceptions of science curriculum and the role of the teacher will facilitate planning to develop effective teaching. I have noticed that through my study, the science pre-service in different years of universities, they have the same background regarding teaching critical thinking skills in science curriculum. Qing et al (2012) did a study on pre-service and in service teachers to test their reflection on critical thinking skills, the study revealed that the pre-service teachers have a high mean score of critical thinking skills reflected than in-service teachers.

Furthermore, the researcher interviewed science pre-service teachers regarding their perception on teaching critical thinking skills to support the study. The findings indicated that the pre-service teachers proved their awareness of the critical thinking term as well as recognized the importance of knowledge and thinking as well as the courage of expression is the basis for all the practices and educational activities. The results focused on pre-service teachers' roles to create a climate that supports the critical thinking skills and creative thinking during the classroom or damage it.

5.2 Conclusions and Implications

Pre-service teachers today face a rapidly changing world and this requires them to keep on track with the changes in basic knowledge and skills in educational life. The basic standards of teaching and learning science curriculum have changed from memorization of the facts to the 21st century development skills such as critical thinking skills, creative skills, media and technology (Urbani et al, 2017). While research exists on each of the 21st-century skills in isolation or in pairs, a scarcity of research exists on the process of explicitly facilitating them

with pre-service teachers (Kagle, 2014; Kokotsaki, 2011; McDonald & Kahn, 2014; Thieman, 2008).

This study aimed to provide the evidences of the effect of critical thinking skills on science instruction, science lesson plans and enhance the science curriculum to be more effective in educational system. A questionnaire, interview and analysis lesson plan were designed for this study, with 80 pre-service teachers participated from different institution. They did their training in different private and public schools in UAE. The quantitative method applied in this research was to find the effect of critical thinking skills through the science instruction of independent variables, which is the critical thinking skills from the pre-service teachers perceptions' on the dependent variables, which is the science instruction and performance of students during the classroom. The conclusion of this study was that the pre-service teachers' perceptions was that critical thinking skills effect the science instruction in a significant way, which made the educational process enjoyable for both students and pre-service teacher as well as stimulated many other skills such as collaborative learning, creative thinking and problem solving.

The study finds that teaching critical thinking skills has been embedded in science curriculum as well as students' level in science education. However, the science curriculum is under progress of developing service education system. These findings have overlapped with many previous studies. The education should not only focus on basic skills and knowledge but rather should focus on teaching the critical thinking skills and creative thinking because these skills are contributory to the self-development for life (Forrester, 2008). Case (2005) found that the critical thinking skills are the lens of content in different curriculum. Regarding the levels of critical thinking in the various disciplines, many researchers found significant differences between university specialties. The levels of critical thinking skills are important for medical, pharmacy students than their fellow students of science and mathematics (Mustafa, et al 2017).

The qualitative method used in this study was to explore more about science pre-service teachers' perceptions. The science pre-service teachers have a simple background to apply critical thinking skills due to educational system not rich with adequate methods, classroom atmosphere and modern techniques. Accordingly, passive educational styles are adopted and generally the education is carried out without attaching enough importance on critical thinking (Bulgurcuoglu, 2016). Many studies have claimed that using specific strategies to enhance the

critical thinking skills in science instructions such as problem solving, dealing with new information and data, self-learning, link between variables and high communication skills (Mustafa, et al 2017). Some skills and abilities of critical thinking cannot be improved in absence of clear instructions. In the other hand, they must recognize the important role of pre-service and in-service teachers in their relationship within the classroom to enhance important skills in science curriculum (Abrami et al. 2008; Case 2005; Facione 1990; Halpern 1998; Paul 1992).

In general, teaching a content-based curriculum that cannot help students to develop their thinking, draw conclusions, think flexibly, creatively, and make decisions. The pre-service teachers believe that using various activities raises critical thinking skills as well as there are studies in Italy that have concluded that there are no specific studies on critical thinking skills (Massa, 2014). Nonetheless, critical thinking skills contribute to understanding the science curriculum as well as prepare the students to be more aware in other skills such as problem solving and decision making (Forawi, 2016). Science pre-service teachers found that teaching and learning through guided scientific knowledge and open-ended question contribute to develop critical thinking skills (Misbah, 2015). Gunn et al (2014) argued, to find a way to understand the implementation of the concepts of critical thinking skills as well as consider that training and encouragement of the teachers on continuous basis to develop science instruction. The term critical thinking is considered as a cognitive, process and habit. In addition, to learn science in effectiveness way depends on implementation of critical thinking process (Mokhtar &Halim, 2015).

5.3 Limitations

The pre-service science teachers in this study have general concepts about critical thinking skills as it was presented from the small sample of pre-service science teachers from different institutes in short time. In general, the UAE' schools depend on the coverage of the science content with knowledge and memorization. Therefore, the science curriculum lacks basic modern skills such as critical thinking skills. Research in field of education needs many tools to gather information accurately. However, the importance of teaching science effectively is dependant on teaching different skills such as critical thinking skills. Furthermore, for a reliable and extensive study, emphasis should be placed on the important factors that support the pre-service teacher in

teaching critical thinking skills also how the student is more active during the science classroom. Moreover, use of important tools such as interview periodically with pre-service teachers to continuously consider the overall level of their teaching in critical thinking skills in science curriculum.

Analyzing the data in this study showed that science pre-service teachers in different years in university have the same level of perception about critical thinking skills. One of the limitations was the researcher who was individually searching about the specific category of sample in this study as well as it was difficult for the researcher to reach all of science pre-service teachers due to lack of time and they were spread in different schools and areas that were distant from each other to do their training.

5.4 Recommendation for the Field

The pre-service teachers can acquire teaching critical thinking skills through modern education. However, the universities should aim to raise the development of knowledge and new information in order to encourage critical thinking skills. Based on many previous researches, the development of critical thinking develops with effect of different aspects such as curriculum, pre-service and in-service teachers' program training and achievement standards (Stancic & Radulovic, 2017). According to the Forawi (2016), the pre-service teachers should be trained to teach critical thinking skills. The science curriculum consist form different conceptions as well as preparing the science curriculum need to consider the goals, contents, methods and materials that will lead to particular purpose. Therefore, integrating critical thinking skills and different approach into the courses in university for pre-service teachers will improve the science curriculum in the future. The curricula are the reflection of education and the reflection of the impact of the goals will be appear on teachers and the students. (Stancic & Radulovic, 2017). Whenever the instructions are clear and directed in return, the students' perceptions of critical thinking skills will increase (Forawi, 2016).

The lesson plan is one of the most essential educational goals. It is referred to as the development of a set of ideas that have a significant impact on the student in the classroom and the teacher must learn to be an actual outline of the lesson plan (McCrea, 2015). The teachers should follow systematic lesson plans that enhance critical thinking skills, so that the student develops this aspect. Whenever the teacher is aware of the importance of the lesson plan, the students will be more enjoyable during the lesson plan. It is critical for the teacher to note the important standards that will meet the lesson plan (Tenkely, 2018). Although critical thinking skills are important skills, they remain somewhat ambiguous in the field of pedagogy (Forawi, 2016). The pre-service and in-service science teachers should put efforts to teach critical thinking skills to the students.

5.5 Recommendations for Further Research

This study investigated pre-service teachers' perceptions of critical thinking in science instruction and lesson planning in UAE' schools. Further research should be done by investigating other pre-service teachers in different universities to expand the perception of critical thinking in science curriculum and lesson plan. Moreover, a research to find the pre-service teachers' perceptions of critical thinking in other fields such mathematics curriculum should be done.

Other studies should examine how to facilitate the teaching of critical thinking skills in science and integrate it into lesson plans. In addition, other researches to find the appropriate activities to develop critical thinking skills in science curriculum. It is recommended to consider the international thinking level tests such as the California critical thinking skills test (CCTST) and the critical thinking assessment test (CAT) to apply it in UAE' educational system in the other studies. The aim of these international tests is to determine the level of the students' thinking and to clarify proposals and solutions for the future development of the student in the field of critical thinking. More studies, in UAE' science curriculum periodically to work on developing 21 century skills to create new thinker generation whom will serve the country as well as more new plans that will integrate the pre-service and in service science teachers in courses in methods of teaching skills critical thinking in science curriculum.

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Appendices

Appendix 1: Permission



05th March 2018

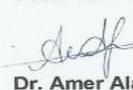
To whom it may concern

This is to certify that Miss. Omelkhair Mohammed Hachlaf with Student ID number 2014101116 is a registered part-time student in the Master of Education - Science Education offered by The British University in Dubai since September 2014

Miss. Hachlaf has successfully completed her taught modules of the programme. She is currently working on her dissertation to complete the programme requirements. On successful completion of her dissertation and validation of the Board of Examiners, she will be awarded the **Master of Education** with a concentration in **Science Education** degree.

This letter is issued on Miss. Hachlaf's request.

Yours sincerely,



Dr. Amer Alaya
Head of Academic and Student Administration

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Appendix 2: UAE University Ethical Committee Approval

Social Sciences Research Ethics Committee -Approval-

Proposal number: ERS_2018_5735

Title of Project: Pre-service Teachers' Perceptions of Critical Thinking of Science Instruction and Lesson Planning in UAE' Schools

PI: Omelkhair Hashlaf

Co-PI: _____

The above proposal has been reviewed by:

- one member of the Social Sciences REC
 two members of the *Social Sciences REC*

And the decision is:

- Favourable
 Favourable with Additional Conditions
 Provisional Opinion
 Unfavourable Opinion
 No Opinion (Proportionate Review* only)

Reason:

After evaluating this proposal, we see no major ethical concerns. Therefore, the proposal is approved for one year.

Please ensure that you indicate to research participants that your study has received ethical approval from UAE University by referring to the proposal number.

Name (Chair or designee): Clara Morgan

Clara Morgan

Signature

April 4, 2018
Date

The decisions available to the Committee are defined as follows:

"Favourable with standard conditions" means that the study has ethical approval to proceed, as long as local management approval is in place prior to the study starting.

"Favourable with Additional Conditions" means that the study has ethical approval in principle but there are certain issues, which need to be addressed prior to the study starting such as a minor change to participant documentation. It is the responsibility of the Principal Investigator to ensure that additional conditions are met.

"Provisional Opinion" means that there are more substantial changes, which need to be made before the study starts. These changes would require further ethical review on the basis of which a favourable or unfavourable opinion would be given by the Ethics Committee.

Unfavourable Opinion means that the study does not have ethical approval to proceed and a further application would need to be submitted should the applicant choose to proceed with the study. Advice and guidance will be provided by the Committee setting out the reasons for their decision and suggesting changes which would mean that a favourable opinion on resubmission would be more likely. For applications processed through the Proportionate Review* Service an unfavourable opinion is only given where the application is of such poor quality that it is probable that an unfavourable opinion would be given if it were to be reviewed at a full meeting.

No Opinion (Proportionate Review* only), means that the Proportionate Review sub-committee (3 members) have deemed that the proposed study does have material ethical issues and will therefore need to be reviewed by a full committee.

**The aim of proportionate review is for studies which present minimal risk or burden for participants to be reviewed by a proportionate review sub-committee within 14 days of receipt of a valid application.*

Appendix3: The Pre-service Science Teachers' Questionnaire

Questionnaire

استبيان

Pre-service Teachers' Perceptions of Critical Thinking of Science Instruction and Lesson Planning in UAE' Schools

تصورات الطلاب الجامعيين الذين يمارسون التدريب العملي في المدارس المختلفة في دولة الإمارات بتأثير التفكير النقدي في تدريس العلوم في الحصة المدرسية والخطة الدراسية.

My name is Omelkhair Hachlaf and I am a Master student in British University, Science Education College. I am conducting this study to understand pre-service teachers' perceptions of critical thinking of science instruction and lesson planning in UAE schools.

This questionnaire is going to ask you about important points in your practices, which might support the learning strategies, and students' learning in science classes. All information that you provide will be confidential and anonymous. There is minimal risk in participating in this study since all data collected will be anonymous.

Your participation in this study is voluntary and you can withdraw any time from the study. For more information, please contact me at this number 0509518536 or email: ahlam.1990@live.com

انا الطالبة أم الخير حشلاف اقوم بتحضير رسالة الماجستير بكلية التربية قسم العلوم , هذا الاستبيان للطلاب الجامعيين الذين يمارسون التدريب العملي في المدارس المختلفة في دولة الإمارات لتدريس العلوم حتى يوضحون أهمية التفكير النقدي في استراتيجيات تدريس العلوم ودعم العملية التعليمية في تدريس الطلاب , جميع المعلومات التي تقدمها ستكون سرية ومجهولة الهوية , وهناك حد أدنى من المخاطر في المشاركة في هذه الدراسة لأن جميع البيانات التي تم جمعها ستكون مجهولة.

مشاركتك في هذه الدراسة طوعية وأوافق على مشاركتك في هذه الدراسة. بالإضافة إلى ذلك , يمكنك الانسحاب في أي وقت من الدراسة. لمزيد من المعلومات , يرجى الاتصال بي على هذا الرقم 0509518536 أو على إيميل . ahlam.1990@live.com

-----I agree to participate in the study voluntarily.

Thank you for your participation.

Omelkahir Hachlaf

Gender	- Female	-Male	الجنس: ذكر / اثنى	
Years of University	-Second Year	-Third Year	-Fourth Year	
السنة الدراسية: سنة ثانية / سنة ثالثة / سنة رابعة				
Grade Level you will teach	-Elementary school	- Middle school		
اي مرحلة صفية قمت بتدريسها / سوف تقوم بتدريسها؟ ابتدائي / إعدادي				
Have you taken a critical thinking course before?	- Yes	- No		
هل أخذت مساق/ كورس عن التفكير النقدي في التدريس خلال دارستك الجامعية ؟ لا نعم				

N	Questions	Strongly Disagree لا أوافق بشدة	Disagree لا أوافق	I don't know لا أعلم	Agree أوافق	Strongly Agree أوافق بشدة
1	Critical thinking focuses on investigation التفكير النقدي يركز على التحقق					
2	Critical thinking encourages open-ended questions التفكير النقدي يشجع على الأسئلة المفتوحة					
3	Critical thinking makes classroom environment attractive for learning التفكير النقدي يجعل البيئة الصفية أكثر نشاطا					
4	Critical thinking generates curiosity between the students التفكير النقدي يولد الفضول بين الطلاب					
5	Critical thinking gives importance to discussion, debate and discourse التفكير النقدي يعطي أهمية للمناقشة بين الطلاب والمعلم في الصف					
6	Critical thinking prepares the students to communicate with real world problem solving التفكير النقدي يهيئ الطلاب لمواجهة مشاكلهم مع العالم الحقيقي					
7	Critical thinking allows the students to make connections and see relationships التفكير النقدي يسمح للطلاب بالتواصل وإيجاد العلاقات بين الأشياء					
8	Critical thinking allows for quiet reflection التفكير النقدي يعطي انعكاس واضح وصريح					
9	Critical thinking makes the students predict events التفكير النقدي يجعل الطلاب متنبئين للأحداث					

	المستقبلية					
10	Critical thinking allows ail students to involve in learning التفكير النقدي يجعل الطلاب المتعثرين في التعليم أن يشاركوا في التعليم والتعلم					
11	Critical thinking helps the students to develop standards to make informed judgments التفكير النقدي يساعد الطلاب تطوير فهمهم وحكمهم على الأشياء من حولهم					
12	Critical thinking helps the students' value different ways of working. التفكير النقدي يعلم الطالب على إعطاء تقييم للعمل					
13	Critical thinking gives opportunities to explore ideas, keep options open and imagine what might be. التفكير النقدي يعطي فرص لاكتشاف افكار جديدة					
14	Critical thinking develops a balance of thinking التفكير النقدي يطور التفكير المتزن					
15	Critical thinking makes the students more creative التفكير النقدي يجعل الطلاب اكثر ابداعا					
16	Critical thinking makes the students analyze the information التفكير النقدي يجعل الطلاب يحللون المعلومات					
17	Critical thinking makes the students evaluate the information التفكير النقدي يجعل الطلاب يقيمون المعلومات					
18	Critical thinking makes the students look for evidence التفكير النقدي يجعل الطلاب أن يبحثوا عن الأدلة لإثبات أرائهم					
19	Critical thinking makes students take Decision in different situations التفكير النقدي يجعل الطلاب يأخذون القرارات النهائية في المواقف المختلفة					
20	Critical thinking makes the students more checking with new information التفكير النقدي يجعل الطلاب يدققون في المعلومات					
21	التفكير النقدي يحفز الطلاب على التعليم التعاوني					

Appendix4: The Pre-Service Science Teachers' Interview Questions

Interview

- In your own words explain what critical thinking means?

من خلال رأيك , اشرح لنا ماذا يعني التفكير النقدي؟

- Why do students need to develop critical thinking skills?

من خلال رأيك , لما يحتاج الطلاب إلى تطوير في تفكيرهم النقدي ؟

-How do you personally use critical thinking skills in daily life, tutoring, and school?

كيف تستخدم التفكير النقدي بشكل شخصي في حياتك اليومية؟

Appendix 5: Lesson Plan Analysis Protocol

Lesson Plan Analysis Protocol

Subject: -----

Level/Class: -----

Lesson Title: -----

Lesson plan Number: -----

	Lesson plan Analysis/ Data analysis
Lesson plan Introduction	
Lesson plan Objectives and Activities	
Lesson plan Materials	
Lesson plan Closure	
Lesson plan Evaluation	
Pre-service Teachers' and Students' Reflection	

Appendix6: Lesson plans

Lesson Plan : The Sun

Teacher Name: Dina Bahhur
Grade: Grade 3
Subject: Science

Topic:	The Sun
Content:	The sun is a star. The sun is the closest star to our planet and the largest, hottest, and brightest object in the solar system.
Goals:	1. View the sun without looking at it. 2. Learn the importance of the sun.
Objectives:	1. Safe "Sun" Glasses experiment. Although the sun may be a fun subject to experiment with, it may also be very dangerous. No one should ever look directly at the sun, doing so may cause damage to eye sight. We are going to use our Safe "sun" glasses experiment to view the sun but not actually look directly at it.
Materials:	Cardboard, White Paper, Pen, Scissors, Tape, Binoculars, Stool or Ladder
Introduction:	Viewing the sun without looking directly at the sun.
Practice:	1. Place the binoculars' eyepieces on the cardboard and draw around them. Cut out the circles you have drawn to make two holes in the cardboard. 2. Push the binoculars' eyepieces through the holes in the cardboard. Tape the board in place, if needed. 3. Cover one of the large lenses(at the opposite end of the binoculars) with a peice of cardboard and tape it in place. 4. Go outside. Tape a sheet of white paper on a wall that is receiving plenty of sunlight. This paper is your viewing screen. 5. Stand about 3 feet away from the white paper screen. Hold the binoculars so sunlight shines through the one exposed large lens. Tilt and turn the binoculars until you see sunlight on your screen. You may need to reposition your screen if the sunlight shows up on another part of the wall. 6. Set the binoculars on a stool or a ladder once you get them in position. Closely observe the Sun's image on the white paper screen. 7. Place a piece of paper on your screen and draw what you see.
Closure:	Explain that the sun mainly contains hydrogen gas. Atoms(tiny particles) of hydrogen at the Sun's core may reach temperatures of up to 27 million degrees Fahrenheit. The higher the temperature, the more quickly atoms move. Fast-moving hydrogen atoms constantly crash into each other and form another gas known as helium. When this happens, energy is released. This energy warms the Sun and causes it to shine.
Evaluation:	After experiment is completed, we will have a classroom discussion and elaborate on what they saw and whether they saw any sunspots.
Teacher Reflections:	1. How do the binoculars allow you to view the Sun safely? 2. Why do you think it is dangerous to look directly at the sun? 3. If you saw dark spots on the screen, what do you think they were?

Water Cycle Lesson Plan

Aim

To learn about the life cycle of water, in particular, the important processes of evaporation, transpiration, condensation, precipitation and collection.

Time requirements

Approximately 60 minutes with an overnight element

Resources

- Interactive water resource
- Whiteboard or projector

Activity 1

- Two pieces of cloth (exactly the same)
- Water
- Air tight plastic bag
- Plate

Activity 2

- Glass jar
- Plate
- Ice cubes
- Very hot water

Learning objectives

To learn about the water cycle through discussion and drawing and to investigate elements of the water cycle through relevant experiments.

Curriculum Strands

SESE, Science – Energy and forces, materials

SESE, Science and Geography – Natural environments and environmental awareness and care

English – Oral language and reading

Maths – Numbers, measures and early mathematics

Skills

Questioning, observing, predicting, discussing, investigating, counting and analysing

Links to Green-Schools

Step 2 Environmental Review – Investigating the life cycle of water

Step 3 Action Plan – Experiments to help understand the life cycle of water

Step 6 Informing and Involving – Posters on the water cycle, put on display on the Green-Schools notice board, inform the school and parents what the students are learning about water

Vocabulary

Water cycle, evaporation, excess, airtight, molecules, condensation, water droplets, solid, liquid and gas

Guided Practice/Interactive Modeling (5 minutes)

- Hand out the Water Cycle Diagram worksheet.
- Tell your students to sit in a circle with the diagram on the floor in front of them.
- Tell your students to put their finger on the picture in the diagram that matches the words you call out.
- Call out the following words: water, sun, evaporation, condensation, cloud, rain, precipitation, water, collection, condensation, rain, cloud.
- Repeat these words until you are confident that your students know their vocabulary.

Independent Working Time (10 minutes)

- Hand out the second page of the worksheet.
- Explain and model how to cut out the labels and glue them to the diagram.
- Instruct your students to raise their hand as they finish the assignment.
- Go to each student as they finish and ask them to point to and describe the parts of the water cycle on their diagram.

Differentiation

- **Enrichment:** Advanced students may label their diagram by writing the words instead of cutting and pasting them on. Students may also use the First Grade Water Cycle Diagram worksheet.
- **Support:** Some students may need extra time to complete the assignment as well as visual and verbal clues to help them finish the diagram.

Topic	Atoms and elements	Lesson Number	3 (Properties of metals and non-metals)
Class	8.2	Ability Range	Medium
Standards		ECM	
Lesson Objectives	<p>All must describe the appearance of metals and non-metals (L4)</p> <p>Most should be able to test the conductivity of metals and non-metals (L5)</p> <p>Some could test the understand the properties of metals and non-metals (L6)</p>		
Knowledge	Pupils should know that metals and non-metals can be separated based on their properties		
Understanding	Pupils should understand the properties of metals and non metals		
Skills	Pupils should be able to test the electrical conductivity of metals and non-metals		
	Worksheets	Practical Resources	Homework
	Properties sheet Metals sheet (homework)	Samples of metals and non-metals Battery Lamps Leads Switch Crocodile clips	Complete metals sheet

Time	Teacher Input	Pupil Input
5 (0.00 – 0.05)	Settle the class and take attendance Take attendance	Pupils get out their equipment and complete task as I am taking the attendance
5 (0.05 – 0.10)	Starter Introduce the objectives	Pupils watch Brainiac video Pupils read through objectives
5 (0.10 – 0.15)	Tell the pupils that we are going to look at the difference between	Pupils listen

	metals and non-metals today	
	How do we know whether something is a metal or non-metal?	Pupils look at their periodic tables
15 (0.15 – 0.20)	Hand out the worksheets	
	Describe how the pupils are to test the samples	
5 (0.20 – 0.40)	Hand out samples of metals and non-metals and get the pupils to complete practical activity	Pupils test samples of metals and non metals
10 (0.40 – 0.50)	Go through what the pupils found and summarize	Pupils give ideas
	Make a list of the properties of metals and non-metals	Pupils give ideas
5 (0.50 – 0.55)	Plenary and homework	Pupils to record homework – metal object with this property sheet
		Pupils complete plenary
5 (0.55 – 0.60)	Re-cap objectives	Pupils do thumbs up, middle, down for objectives

Lesson Plan: All Around the Body

Teacher Name: Rebecca Casaus

Grade: Grade 4

Subject: Science

Topic:	Systems of the Body: Circulatory, Nervous, Digestive and Respiratory
Content:	Circulatory, Nervous, Digestive and Respiratory System stomach lungs brain heart trachea capillary skin intestine esophagus spinal cord arteries nose
Goals:	Students will know the parts of the body that make up each of the 4 body systems. Students will know what each system's function is within the body.
Objectives:	Students will be able to create a life sized, internal diagram of the 4 body systems. Students will be able to write about each system: which body parts make up the system and their function.
Materials:	Internet, encyclopedias and library books, Large chart paper, markers, construction paper, scissors, glue, pictures of the body parts, The Magic School Bus Inside the Human Body, worksheets: Systems of the Body and All Around the Body, Research Page
Introduction:	A. I will read aloud to the students, The Magic School Bus Inside the Body. Brainstorm with the class to try to name as many organs in the body as possible.
Development:	A. We will discuss the sequence as we read. B. I will model how to do an interview.
Practice:	B. Students will be placed in cooperative groups of 3-4. Two students will research, one will write and the other will be on the interview panel. Students will complete the Research Page.
Accommodations:	Students will learn the basic vocabulary associated with their body system.
Checking For Understanding:	Each student will: complete sequence sheet, produce a written summary coming from the interview process. Each team/group will create a lifesized, internal diagram of the 4 body systems. Students will be able to write a paragraph about each system: which body parts make up the system and their function.
Closure:	Each group will present their life sized diagram of the body and their systems.

Seeing the Invisible

Introduction

Carbon dioxide is an odorless, colorless gas. In this demonstration, place several lit candles on ramp, create some invisible CO_2 gas in a beaker, and then “pour” the CO_2 down the ramp. Students will observe the presence of the gas as successive candles are extinguished.

Concepts

- Buoyancy
- Gas density

Materials (for each demonstration)

- | | |
|--------------------------------------|--|
| Baking soda, NaHCO_3 , 10 g | Matches |
| Balance, 0.1-g precision | Ramp, clear plastic, 30 inches |
| Beaker, 600-mL | Ring stand |
| Buret clamp | Tea candles, 5 |
| Clay, modeling | Vinegar, $\text{CH}_3\text{CO}_2\text{H}$, 100-mL |
| Graduated cylinder, 100-mL | Weighing dish |

Safety Precautions

Vinegar may be irritating to skin and eyes. Wear chemical splash goggles whenever working with chemicals, heat or glassware. Please consult current Safety Data Sheets for additional safety, handling and disposal information.

Procedure

1. Attach a buret clamp to the ring stand. Place the clamp about seven inches above the base. Rotate the clamp so that it faces away from the ring stand base (see Figure 1).
2. Equally space and attach the five tea candles to the ramp with modeling clay, so that the candles are angled up from the surface of the ramp.
3. Place the top of the ramp on the buret clamp and the bottom of the ramp on the bench top. Secure the bottom in place with a piece of modeling clay (see Figure 2).
4. Adjust the position of the tea candles so that they are parallel to the bench top.
5. Mass 10 grams of baking soda and transfer the baking soda to the 600-mL beaker.
6. Measure out 100 mL of vinegar in a graduated cylinder.
7. Light the five tea candles.
8. Bring the 600-mL beaker up to the edge of the ramp, tilt the beaker 45 degrees, and then slowly add the vinegar to the beaker. Make sure the foam does not pour over the edge of the beaker and down the ramp.
9. Watch the candle flames go out one by one as the carbon dioxide “pours” down the ramp!

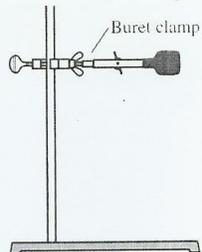


Figure 1.

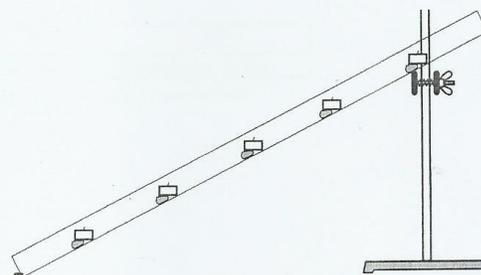


Figure 2.

Disposal

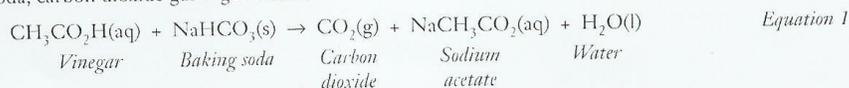
The reaction solution may be disposed of according to Flinn Suggested Disposal Method #26b. Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures governing the disposal of laboratory wastes.

Tips

- Practice the demonstration until you are comfortable producing the correct amount of carbon dioxide when adding the vinegar to the beaker. Pick a demonstration area that is free from drafts and air currents.
- A variation of the demonstration uses an aquarium tank. Use blocks to place the candles at different heights. Place the beaker with baking soda in the bottom of the aquarium. Slowly add the vinegar to the beaker. The CO₂ will displace the air, extinguishing the candles from the bottom to the top.

Discussion

Carbon dioxide is more dense than air—the density of CO₂ is 1.80 kg/m³ at STP, while that of air is 1.29 kg/m³. When vinegar is added to the baking soda, carbon dioxide gas is generated.



As the amount of CO₂ increases, it flows over the lip of the beaker and down the ramp. The candles are extinguished one by one as the column of CO₂ flows over them.

NGSS Alignment

This laboratory activity relates to the following Next Generation Science Standards (2013):

Disciplinary Core Ideas: Middle School

MS-PS1 Matter and Its Interactions

PS1.A: Structure and Properties of Matter

Disciplinary Core Ideas: High School

HS-PS1 Matter and Its Interactions

PS1.A: Structure and Properties of Matter

Science and Engineering Practices

Developing and using models

Constructing explanations and designing solutions

Crosscutting Concepts

Cause and effect

Stability and change

Acknowledgment

Special thanks to Jesse Bernstein, Miami Country Day School, Miami, FL, for sharing this demonstration with Flinn Scientific.

The *Seeing the Invisible* is available as a Chemical Demonstration Kit from Flinn Scientific, Inc.

Catalog No.	Description
AP7046	Seeing the Invisible—Chemical Demonstration Kit

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.

Lesson Plan Seeing the Cell as a System (Grade 8)

Estimated Time: 4–5 class periods.

Central Benchmarks

Within the cell are specialized parts for the transport of materials, energy capture and release, protein building, waste disposal, information feedback, and even movement. In addition to these basic cellular functions common to all cells, most cells in multicellular organisms perform some special functions that others do not.

11A Systems (9-12)#1

A system usually has some properties that are different from those of its parts, but appear because of the interaction of those parts.

Objective

Students will be able to explain how the components of a cell operate as a system.

Advance Preparation

Students should have had many experiences using the microscope to observe different kinds of cells. They should know that the processes necessary for life take place within each cell.

List of Materials

For the class:

Bicycle

TRANSPARENCIES:

The Bicycle as a System

Questions to Ask About Systems

Paramecium

For each group of four students:

An item which may be considered a system, such as the classroom aquarium, the classroom pencil sharpener, a clock or watch, a plant, a student's notebook, a balance, a mechanical toy, a model of the human eye, a hot plate, a flashlight, etc.

A microscope and slide-making equipment (deep well slides may be desirable)

Culture of paramecia

Prepared slides of human body cells

For each student:

HANDOUT:

The Bicycle as a System

Questions to Ask About Systems

Paramecium

It is important throughout this lesson that students focus on functions of parts of systems rather than on names of parts of systems. Students will need to name such cell parts as nucleus and cell membrane. However, it is not necessary for students to memorize the names of many cell organelles. For example, rather than learn the name endoplasmic reticulum, students should know that there are paths through a cell by which materials move.

Motivation

Presenter: You have all heard the terms ecosystem, school system, sound system, solar system, and other kinds of systems. Let's explore today what we mean when we say something is a system. Have students work in pairs to develop a definition of "system." Have several responses shared. Focus on a definition that suggests that a system is something made of parts in which the parts interact.

2. Examples of systems.

Have students work in pairs to brainstorm a list of at least ten systems. Each pair should then share its list with another group. Have each group confirm that they agree that the items listed can be considered as systems.

3. Analyzing a system.

Organize the class into small groups of three or four students. Give or assign to each group an item that can be considered a system (see the List of Materials).

Show the TRANSPARENCY and distribute the HANDOUT: Questions to Ask About Systems.

Have students work in their groups to answer the questions. Answers will vary according to the

system being analyzed.

Have each group share its answers with another group. If there are differences of opinion, have these discussed by the whole class.

Summary

Have one or two students describe the activities completed in this lesson.

Evaluation

- Have each student complete a journal entry listing at least five generalizations about systems.
- Have students compare the functions that occur inside a cell with the functions that occur in a factory where some item is manufactured. Have students use graphics in presenting their comparison.

Extensions

- Have students investigate feedback and control in the regulation of body temperature in humans.
- Have students research regeneration, as in starfish or worms.
- Have students research genetic engineering.

Appendix 7: The lesson Plans presented during the Pre-services Teachers' Classrooms.

	Lesson plan 1 “The Sun”	Lesson plan 2 “All Around the Body”	Lesson plan 3 “Water Cycle”	Lesson plan 4 “See the Invisible”	Lesson plan 5 “Life System- Cells”	Lesson plan 6 “Atoms and Elements”
Lesson plan Objectives	1-Viewing the sun without looking 2-Learning the importance of sun	1-Identifying the parts of the body 2-Identifying the system function	1-Identifying the life cycle of water 2-Identifying main concepts in water cycle such as “ Evaporation”	1-Identifying the important concepts such as solid, liquid and gas	1-Identifying the main structure and functions of animals’ and plants; cells	1-Identifying the metals and non-metals 2-Understanding the properties of metals and non-metals
Lesson plan Introduction and Activates	The lesson was for grade 3 as well as the lesson objectives were clear. The teacher started with basic questions to introduce the topic and let the students ask by themselves “students-center”	The lesson was for grade 4 as well as the objectives were appropriate for students level, The teacher divided the students into groups to explore the lesson purposes by themselves “ Student-center”	The lesson was for grade 5 as the objectives were appropriate for students’ level. The teacher starts a lecture that includes the pervious lessons “ The importance of water in life” and asks the students the main questions, after that the teacher proceeds to the activity	The lesson plan was for grade 7 as well as the objectives were limited, The teacher supported the students with Laboratory tools and identified each tool to start do experiments.	The Lesson plan was for grade 8 as well as the objectives based on previous students back ground, The teacher provided the students with important vocabulary that supported the topic.	The lesson plan was for grade 8 as well as the objectives based on previous lesson plans, The teacher provided the students with a video to introduce the topic as well as different resources that supported the lesson plan.
Lesson plan Materials	The materials that were used in the lesson plan were supported by the development skills, such as identifying the tools based on previous background.	The materials were simple, but provided the lesson plan, for example, the students used internet to get external information about the body system.	The materials were distributed among groups to do the experiment.	The students were so active and curious to find the final results by themselves.	The tools were prepared by the students the day before the lesson. “student-center”	The students were divided into groups to do an experiment and identify the tools by themselves and write it in the work sheet “student-center”
Lesson plan Evaluation	After the experiment, the teacher discussed with students the results to evaluate them.	At the end, the teacher evaluates the students by each group choosing one body system and explaining it in front of other groups.	The teacher evaluates the students during the activity by describing the water cycle verbally	The teacher wrote in the board the final result and discussed new concepts with students.	The teacher used pre- test and post- test to evaluate the students. In addition, leaving the students to evaluate each classmate.	The teacher provided the students with homework to evaluate them in the next day.

Lesson plan Closure	The teacher ends the lesson plan by identifying the new concepts about sun for students such as “Hydrogen Gas”.	No closure	The teacher ends the lesson plan by asking questions related to their activities	The teacher closes the lesson plan by identifying new concepts about How to See the Invisible for students such as “Gases Mass and Carbon Dioxide”	No closure	The teacher closes the lesson plan by re-cap the lesson plan objectives.
Pre-service Teachers’ and Students’ Reflection	The teacher’ and students ‘reflections on lesson plan opened new questions for new topics for example “How the binoculars allow to see the sun?”	No reflection	The teachers’ and students’ reflections on lesson plan contribute to learning new concepts such as “Condensation” and “precipitation”.	No reflection	The teacher’ and students’ reflections on lesson plan contribute to learning new concepts about cell ingredients.	No reflection