Measuring Critical Thinking Aptitudes of High School Students in a Private School in Dubai

قياس قدرات التفكير النقدي لدى طلاب المرحلة الثانوية في مدرسة خاصة بدبي

by

GILAN MAGDI ALI RASLAN

A dissertation submitted in fulfillment

of the requirements for a degree of

MASTER OF EDUCATION

at

The British University in Dubai

June 2022

DECLARATION

I warrant that the content of this research is the direct result of my own work and that any use made in it of published or unpublished copyright material falls within the limits permitted by international copyright conventions.

I understand that a copy of my research will be deposited in the University Library for permanent retention.

I hereby agree that the material mentioned above for which **I** am author and copyright holder may be copied and distributed by The British University in Dubai for the purposes of research, private study or education and that The British University in Dubai may recover from purchasers the costs incurred in such copying and distribution, where appropriate.

I understand that The British University in Dubai may make a digital copy available in the institutional repository.

I understand that I may apply to the University to retain the right to withhold or to restrict access to my thesis for a period which shall not normally exceed four calendar years from the congregation at which the degree is conferred, the length of the period to be specified in the application, together with the precise reasons for making that application.

Student's Signature

COPYRIGHT AND INFORMATION TO USERS

ABSTRACT

For nearly 60 years and more, educators and policymakers have highlighted the need to graduate students who are good critical thinkers, from classrooms to workplaces.
To meet the demands of the twenty-first century, critical thinking abilities are essential.
Critical thinking is defined as a collection of basic skills that must be mastered before moving on to more complex thinking. In order to gain a better insight into various aspects of critical thinking, the current study specifically measures the critical thinking aptitude of high school students in a private school in Dubai. From a population size of 291 students, 91 students from grades 10 and 11 were taken as a sample size for high school students in this private school. This is a unique study whose hypothesis stressed the science online instructions for students and teachers in the school context. This research is a quantitative, descriptive case study using a modified 40-question W-GCTA test to collect the data. Norms and scoring analysis were done by conducting one-sample t tests, section analysis was done by conducting one-way repeated-measures ANOVA, while independent-sample t tests were used to test demographic differences. The study's findings revealed that the students possess a critical thinking aptitude above the average percentage, with a total score of 76%. This is in contrast with studies discussed in literature. However, other implications regarding curriculum modifications, educational teaching strategies, and teachers' readiness are needed to foster students' critical thinking skills. For future research, increasing the sample size by involving more schools would be better, since the present study is focused exclusively on the quantitative data. It is also recommended that qualitative research might also be conducted to obtain reliable and rigorous results.

Keywords: critical thinking, W-GCTA test, critical thinking aptitude, teachers' readiness

نبذة مختصرة

لما يقرب من 60 عامًا وأكثر، سلط المعلمون وصانعو السياسات الضوء على الحاجة إلى تخريج طلاب يتمتعون بتفكير نقدي جيد، من الفصول الدراسية إلى أماكن العمل. لتلبية متطلبات القرن الحادي والعشرين، فإن قدرات التفكير النقدي ضرورية. يُعرَّف التفكير النقدي بأنه مجموعة من المهارات الأساسية التي يجب إتقانها قبل الانتقال إلى التفكير الأكثر تعقيدًا. من أجل الحصول على رؤية أفضل في مختلف جوانب التفكير النقدي، تقيس الدراسة الحالية على وجه التحديد قدرة التفكير النقدي لدى طلاب المدارس الثانوية في مدرسة خاصة في دبي. من عدد يبلغ 291 طالبًا، تم أخذ 91 طالبًا من الصفين العاشر والحادي عشر كعينة لحجم طلاب المدارس الثانوية في هذه المدرسة الخاصة. هذه دراسة فريدة أكدت فرضيتها على تعليمات العلوم عبر الإنترنت للطلاب والمعلمين في سياق المدرسة. هذا البحث عبارة عن دراسة حالة وصفية كمية باستخدام اختبار W-GCTA المعدل المكون من 40 سؤالًا لجمع البيانات. تم إجراء تحليل المعايير والتسجيل من خلال إجراء اختبارات t لعينة واحدة، وتم إجراء تحليل القسم عن طريق إجراء ANOVA ذات المقاييس المتكررة أحادية الاتجاه، بينما تم استخدام اختبارات t للعينة المستقلة لاختبار الاختلافات الديموغرافية. كشفت نتائج الدراسة أن الطلاب يمتلكون قدرة تفكير نقدي أعلى من النسبة المئوية المتوسطة، بمجموع نقاط 76٪. هذا على النقيض من الدراسات التي نوقشت في الأدب. ومع ذلك، هناك حاجة إلى تداعيات أخرى تتعلق بتعديلات المناهج واستراتيجيات التدريس التربوي واستعداد المعلمين لتعزيز مهارات التفكير النقدي لدى الطلاب. بالنسبة للبحوث المستقبلية، سيكون من الأفضل زيادة حجم العينة من خلال إشراك المزيد من المدارس، حيث تركز الدراسة الحالية حصريًا على البيانات الكمية. يوصى أيضًا بإجراء بحث نوعي للحصول على نتائج موثوقة ودقيقة.

الكلمات الرئيسية: التفكير النقدي، اختبار W-GCTA، كفاءة التفكير النقدي، استعداد المعلمين

DEDICATION

I would proudly like to express my utmost gratitude to my father **Magdi Ali Raslan**. He gave me the gretaest gift a parent would ever give to his child, ‘he believed in me’.

This dissertation is dedicated to you, my beloved father.

Thank you for your encourgement and your support to pursuie my dreams.
There is no single day that I do not remember you. You are always missed. You are irreplaceable. I love you. My Allah grant you one of highest ranks in jannah.

ACKNOWLEDGMENT

Life is about accepting the challenges along the way, choosing to keep moving forward, and savoring the journey." ― Roy T. Bennett.

First and foremost thank you Allah the Almighty and the Most Merciful for all the blessings in everything I do, for giving me endless strength and patience to continually search for who I am in this world, for granting all my prayers and success to be a better person, and for surrounding me with the most beautiful people who are always praying for my success. Those people are the wind beneath my wings.

I would like to deeply and sincerely thank my research supervisor, Prof. Sufian A. Forawi for his excellent advice and guidance in wtiting this resarch. His vision, sincerity and motivation have deeply inspired and motivated me all throughout.

TABLE OF CONTENT

LIST OF ILLUSTRATIONS

Figures:

Charts:

LIST OF TABLES

CHAPTER 1

INTRODUCTION

1.1 Background:

Skills matter, and poor skills severely hinder access to better-paying and more gratifying professions, according to a recent study conducted by the Organization for Economic Co-operation and Development (OECD 2016, 2018). Unsurprisingly, critical thinking skills, have become a fundamental educational focus in recent decades (OECD 2016; Forawi 2020; Starichkova, Moskovskaya & Kalinovskaya 2022). Because CTS act as a catalyst, students are able to go beyond simply gathering knowledge to developing a deep grasp of the information offered to them (Amin & Adiansyah 2018; Setyawan & Mustadi 2020). As a result, its most significant contribution is to promote good decision-making and problem-solving in real-world settings (Perez 2019; Forawi 2020).

Mastering the content of information, skills, and competence in the twenty-first century requires a shift in learning orientation (Marni et al. 2022; Miterianifa et al. 2021). Students must be able to think, act, and live in order to study in the twenty-first century. One of the life skills, according to the Partnership for 21st Century Skills, is the ability to think critically (Saleh 2019). Furthermore, students at the college level and in the industry demand critical thinking skills and skills assessment. (Forawi 2020; Abdulah & Wangid 2021).

A start-up definition of Critical Thinking or CT, is "the skill of thinking about thinking in order to improve thinking." (Paul & Elder 2019, p.17). Paul and Elder (2019) combined multiple definitions to generate the following definition: "Thinking specifically targeted at well-founded judgment, employing acceptable evaluative standards in an attempt to discover the genuine worth, merit, or value of anything" (Forawi 2020). Many core thinking skills, such as decision making and metacognition, are directly linked to critical thinking in various career domains and in everyday life. Because critical thinking and decision making are so intertwined, some experts consider decision making to be the ultimate goal of critical thinking (Ennis, 2015).

According to Glaser (1941), critical thinking requires an awareness of logical inquiry and reasoning techniques. Some views hold that critical thinking is dependent on acquired abilities or

skills (Hitchcock 2018, 2020). However, it is not immediately clear that a competent mental act represents the application of a generic acquired talent (Elder 2019). Because outstanding critical thinking performance cannot be separated from knowledge of ideas and domain-specific principles of excellent thinking (Forawi 2020). In accordance with Ennis (2015), critical thinking depends on an individual's capacity and consists of some skills and tendencies.

In the education field, the true educational purpose is for students to recognize, embrace, and implement such criteria and norms. Adoption and implementation require the acquisition of critical thinking knowledge, talents, and dispositions (Ennis 2015; Santos 2017). Dewey (1910) believed that reflective thinking education would benefit both individuals and communities, recognizing the connection between a child's sense of wonder, myopic viewpoint, and love of investigational inquiry in educational practice "would make for individual happiness and the reduction of social waste" (Hitchcock 2020). Future-oriented and current education is primarily concerned with developing students' CT ability in different aspects of life (Sadhu et al. 2019). As a result, critical thinking is a valuable skill that should be taught and developed (Abazar 2020). Many research studies have shown that critical thinking can be taught just like any other skill. These cognitive skills can be learned either as part of a subject's instruction or separately (Taleb & Chadwick 2016; Hitchcock 2017; Forawi 2020). Researchers believe that thinking skills should be incorporated in instruction because of their importance in everyday life in contemporary societies (Forawi 2020; Hitchcock 2020). The importance of fostering critical thinking abilities in students at K-12 educational institutions may be demonstrated in its consideration as a university admissions and graduation criterion.Furthermore, research highlights that demonstrating critical thinking skills to employers, educators, and students is crucial (Danczak 2018; Abazar 2020).

In light of the foregoing, it appears that institutions all over the world are tasked with developing "the talents" those modern civilizations require to thrive. K-12 educational institutions in UAE, in particular, should pay close attention to the various aspects that may influence students' CTS gains (Hitchcock 2017). Based on the literature, the major pattern that emerges when identifying aspects of success in education is the 'academic experiences'. Although a variety of institutional elements might influence student achievement in school, academic experiences are

thought to have the greatest impact on a student's performance, as it has a great deal to do with both learning and academic success (Gbollie & Keamu, 2017; Perez, 2019; Forawi, 2020; OECD, 2020). When the Human Terrain System training and instruction directors in the United States realized how important critical thinking skills were to graduates, and how ineffectively some were using them, they began to rethink what was taught in their curriculum, how it was taught, and how the outcomes were measured (Griffin & McClary, 2015). According to the 2013 curriculum, critical thinking skills in chemistry study will adequately equip students with skills to interactor and seek greater information as the cornerstone for many basic and applied fields (Hitchcock 2020).

Despite the fact that CT abilities are a crucial attribute required in higher education and the profession, (OECD 2018; Danczak et al. 2019) assert that they are rarely properly assessed. Assessment of advanced thinking abilities should not be done in isolation, but rather as part of the overall learning environment in order to detect students' intellectual potential learning, as well as to maintain or enhance the learning process (Nurfatihah et al. 2021). Many critical thinking assessment techniques, like the well-known Watson-Glaser critical thinking evaluation (Watson & Glaser, 1964), examine decision-making as well (Halpern 2016; Planter & Williford 2017).

1.2 Statement of the Problem:

Educating critical thinkers has become a focus for education institutions around the world in the recent decade, especially since it was identified as one of the most crucial abilities in the twenty-first century. This worldwide trend in education has sparked a surge in interest in critical thinking skills (Perez 2019; Forawi 2020). In recent years, societies have increased their demands for an education that produces critical thinkers capable of succeeding in a globalized environment (Forawi 2020). Critical Thinking Skills or CTS have been positioned as one of the key educational goals in education as a result of the current migration of educational systems toward a more explicit focus on the skills that 21st century society requires and demands (Santos 2017; Zihan et al. 2022). Stakeholders, academics, and politicians agree that acquiring CTS is critical for the social and economic advancement of countries around the world (Di, Danxia & Chun 2019; Perez 2019).

However, youth have an especially low level of critical thinking. 92.1 percent of businesses questioned by a consortium of US organizations regarded college students "to be 'poor' in critical thinking," according to the report (Davies & Barnett 2015). Having said that education systems

have openly endorsed critical thinking skills on a policy level, K-12 educational institutions must close two significant gaps: they must first analyze the students' critical thinking aptitude and second, these educational institutions must determine which changes are needed to be considered to support critical thinking development in students (Arslan, Gulveren & Aydin 2014; Perez 2019).

The Ministry of Education's (MoE) Strategic Plan 2017-2021 aims to ensure comprehensive quality education, primarily high-school education, and to create an innovative culture in the workplace in the framework of the UAE and the national agenda (MoE 2022).

It takes on much more significance now since ensuring students have critical thinking abilities is vital to building a competitive knowledge-based economy, thereby helping to diversify the country's industries and correcting the country's workforce demographic imbalance (GCC Education Industry 2018; Sarker & Rahman 2018).

The scenarios show that ensuring highly skilled Emirati workers with essential skill sets are accessible in an innovative economy is critical to the country's long-term economic stability and capitalization on current oil wealth (Forawi 2020). Despite the fact that the UAE supports the development of critical thinking skills as a fundamental educational goal, studies on evaluating students' critical thinking aptitude in schools are scarce, and there is a dearth of empirical research on this topic in the UAE.

1.3 Significance of the Study:

The need to reform K-12 curricula to incorporate critical thinking development and raise student knowledge and application of reasoning abilities has evolved in the last decade (Mahmoud & Mohamed, 2017). According to numerous researches (Nornoo, Jackson, & Axtell; Cone et al. 2016), current institutions must incorporate thinking skills courses within their curriculum so that students have a platform to build their thinking skills. In addition, students will not be able to foster their critical thinking aptitude unless educational institutions establish effective teaching methodologies (Lee et al. 2016; Forawi 2020). The ability to respond to questions about students' learning is critical to the act of teaching and learning. We must shift from a "hopeful pedagogy" to one that is based on evidence of student learning. This act will not only meet the requirements for accountability, but it will also strengthen the integrity and quality of teacher service and the foundations of K-12 education (Nicholas & Raider-Roth 2016).

The current study has the potential to assist policymakers on practical measures for improving critical thinking ability of students in schools. Teaching critical thinking can be difficult, and various issues might arise. Low-achieving students, for example, can quickly become overwhelmed and isolated. Furthermore, there is virtually little support and training available for high school instructors who want to incorporate critical thinking into their curriculum (Halpern 2016). Also, critical thinking can be evaluated in as many ways as it can be defined. Some tests look at the dispositional aspects of critical thinking, while others measure cognitive abilities (Hitchcock 2020). Few studies have looked at how teenagers employ critical thinking from both a skills and a dispositions perspective. Evaluating both components can help us determine whether or not the media education provided in school is effective, and if not, which CT skill of students is in need to be fostered (Halpern 2016; Hitchcock 2020).

1.4 Purpose of the Study:

The purpose of this research is to examine the level of critical thinking aptitudes of high school students in a private school in Dubai. To fulfil this purpose, students' general level of critical thinking as well as their level of skill in specific areas are measured. The tool used in the study is W-GCTA test, and it can be used to determine which of these skills a student is particularly strong in and which of these he/she uses more freely and frequently.

In the context of this study, the following research questions are raised:

1- What critical thinking aptitudes do high school students in a private school in Dubai have as measured by the W-GCTA test?

2- Are there any demographic differences among high school students regarding their critical thinking aptitudes as measured by the W-GCTA test?

CHAPTER 2

THEORECTICAL FRAMEWORK & LITERATURE REVIEW

CONCEPTUAL FRAMEWORK

2.1 The Concept of Critical Thinking

The words 'critic,' 'Critic,' 'Criticicism,' and 'Critic' are all synonyms of the ancient Greek term 'Kritikos,' which means 'able to authorise, perceive, or decide. 'In modern English, a 'critic' is someone who is paid to pass judgment on items like movies, books, music, and food. It necessitates presenting an objective and unbiased stance on any topic (Padmanabha 2021). CT is a reflective decision-making process that includes objective examination and justifications based on relevant and verified fact (Hasan & Pri 2020). Thinking for the sake of thinking is not the same as critical thinking. It's metacognitive, which means it requires you to consider your own thinking (Forawi 2020). According to Hidayati and Sinaga (2019), critical thinking necessitates rational and exegetical coherence in order to detect biases and incorrect reasoning, and it also necessitates logical and interpretative coherence, and it is crucial that students practice it.

In education, critical thinking is not a new notion. Socrates (469–399 BCE), the first instructor to teach the practice of thinking, encouraged doubt in his students to promote their search for truth. Plato, Aristotle, and the Greek skeptics later adopted Socrates' questioning approach to critical thinking, emphasizing that things are often not what they appear to be. This ancient Greek tradition arose from the desire to comprehend deeper truths by thinking logically, tracing implications, and delving beyond the surface of each piece of knowledge (Paul, Elder & Bartell 1997; Paul & Elder 2006; Lombardi et al. 2021). Its modern beginnings can be traced back to John Dewey (1933), a famous educational theorist who emphasized the significance of so-called reflective thinking as a fundamental skill for pupils in the early twentieth century. It was dubbed critical thinking later on. According to Dewey (1933), critical thinking is "an active, persistent, and intentional study of a viewpoint based on a firm foundation of facts." Critical thinking, together with creative thinking, decision-making, and problem-solving, was widely recognized as one of the four components of the ability to think in the twenty-first century (Lombardi et al. 2021). Critical thinking is regarded as one of the most important 21st century skills in education, alongside creativity, communication, and cooperation (the "4 C's") (UNESCO-IBE 2013; Lombardi et al. 2021).

Several authors (Paul et al. 2006; McPeck 2016; Lombardi et al. 2021) continued to work on a definition of critical thinking by highlighting the skill and its disposition-based characteristics,

but there was no unanimous agreement. As a result, experts, scientists, educators, psychologists, and philosophers have yet to reach an agreement on a conceptual definition of critical thinking.

The current study employs UNESCO's (2013) definition of critical thinking, which states that it is a process that includes asking pertinent questions, trying to gather information, and skillfully categorizing necessary details, connecting new information to prior knowledge, reexamining assumptions and beliefs, reasoning rationally, and drawing professional and trusted conclusions. The emphasis on the continual effort required to perfect critical thinking abilities is a significant reason for using the UNESCO (2013) definition (Perez 2019). In doing so, it is critical to use theoretical conceptions to comprehend a situation, assess data, and evaluate strategies or techniques for making a decision (Perez 2019).

2.2 Components of Critical Thinking

Critical thinking skills include analyzing arguments, drawing inferences using inductive or deductive reasoning, diagnosing or evaluating, and making decisions or addressing issues (Paul and Elder 2020). Both cognitive ability and personality attributes are required for critical thinking. For critical thinking to be viable within a certain subject, background knowledge is required, but not sufficient (Forawi 2020). These characteristics, which can be termed attitudes or habits of mind, include open-mindedness and fairness, intellectual curiosity, adaptability, a predisposition to seek reason, a desire to be well-informed, and a respect for and willingness to entertain diverse viewpoints (Facione 2015; Elder and Paul 2020). Critical thinking has both general and domain-specific components (Facione 2015). People begin acquiring critical thinking skills at a young age, according to empirical study (Facione 2015; Perez 2019; Elder and Paul 2020).

Aptitude, on the other hand, is a set of knowledge, abilities, and behaviors that are cultivated for the purpose of self-improvement, according to the United Nations Industrial Development Organization (UNIDO) (Bissonnette, Chastenay & Francoeur 2021). Salleh (2021) defines competence as a range of capabilities, beliefs, and attitudes that contribute to higher performance (Taimur & Sattar 2019). Competence, according to Rychen and Salganik (2001), comprises the ability to meet complex demands through developing psychological resources such as talents and attitudes in a specific situation, as well as knowledge and skills ((Taimur & Sattar 2019). Therefore, critical thinking might be classified as aptitude in this context. Individuals must possess

(a) critical thinking skills, (b) specific cognitive abilities, and (c) specific attitudes and dispositions such as truth-seeking, open-mindedness, and judgment maturity to think critically (Stupple et al. 2017; Taimur & Sattar 2019).

These three elements are combined to solve some critical thinking tasks as an aptitude/ competency. Figure 1 below shows a critical thinking aptitude/competence model based on three aspects:

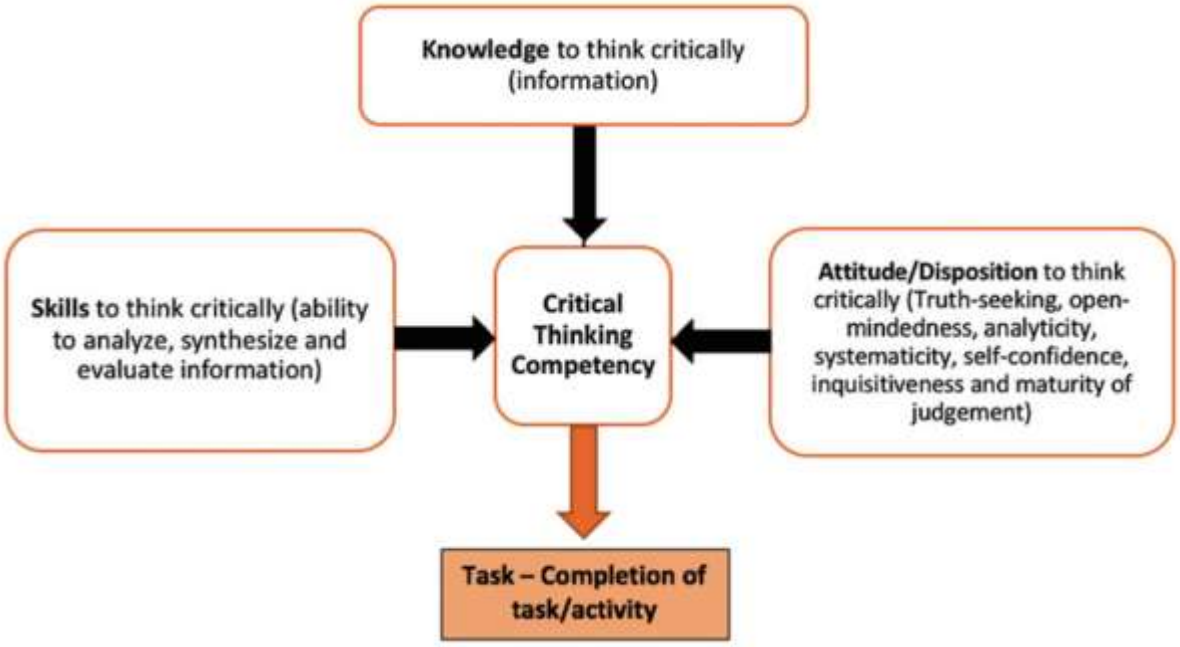


Figure 1: Main Aspects of Critical Thinking Aptitude/Competency
Adopted from: Taimur & Sattar (2019)

2.3 Defining Academic Experiences

In the context of the current study, academic experience is defined as any work experience obtained in an academic environment (Perez 2019). The term "academic" refers to work done in schools, colleges, and universities that focuses on studying and understanding rather than practical or technical skills (Bouilheres et al. 2020). In K-12 education, student academic experience has a significant impact on achievement and learning. It reflects the quality of instruction and is a good predictor of student academic achievement and the output of the institution (Cummings et al 2017). Academic experiences, according to Collaço (2017), are characterized as student engagement, interaction with peers and teachers, and enjoyment with the learning process. Many studies

(Cummings et al 2017; Perez 2019; Bouilheres et al. 2020). defined academic experiences as having behavioural, interpersonal, and affective components that must be addressed if authentic learning is intended.

Although a variety of institutional elements might influence a student's performance in schools, academic experiences are thought to have the greatest impact on academic success (Perez 2019). Classroom experience, on the other hand, must be considered the most significant critical aspect in a student's performance (Budsankom et al. 2015; Paul & Jefferson 2019), as it has a great deal to do with both learning and academic success (Budsankom et al. 2015; Paul & Jefferson 2019; Perez 2019). Learning outcome, desirable student qualities, and vocational training procedures such as critical thinking skills are all aspects that influence the atmosphere for effective teaching and learning (Budsankom et al. 2015).

Even though there were results demonstrating that elements impacting academic experiences changed and varied, according to several studies' analysis (Budsankom et al. 2015; Paul & Jefferson 2019; Perez 2019; Forawi 2020) academic experiences affecting CTS can be categorized into three categories; 1) Classroom Environment: this term describes both the physical and psychological aspects of a learning environment, such as tidiness, cleanliness, light, and size, as well as the psychological aspects of safety, warmth, and excellent relationships, as well as the freedom to express ideas and feelings. 2) Teaching and Learning Methods: These are the concepts, methods, patterns, and processes that teachers employ to control students' learning and achieve classroom management objectives (Eun & Mi-Suk 2018; Paul & Jefferson 2019; Perez 2019). Finally, 3) Teacher Behavior refers to the activities that teachers engage in in order to stimulate, facilitate, and encourage pupils to accomplish their best work in the classroom (Prokhorova & Vaganova 2019; Okechukwu 2021).

THEORETICAL FRAMEWORK

This section consists of implementation of models which translates critical thinking skills and attributes into aspects to be assessed. The theoretical framework of this research (see Figure 2) is grounded on the RED Critical Thinking Model which defines the key aspects of the critical thinking

process. In addition, this section discusses Paulian theory for the elements of thoughts and the attribution of Bloom's taxonomy in the process of critical thinking.

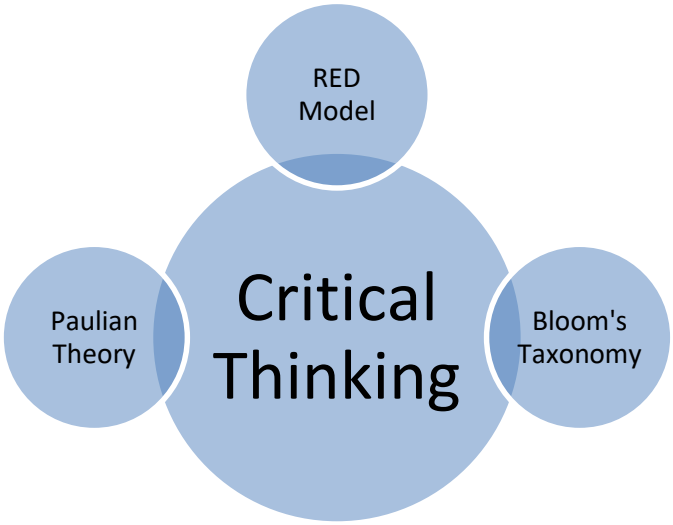


Figure 2: The Theoretical Framework used to Guide this Study

2.4 The RED Critical Thinking Model

Critical thinking is related with a variety of talents and traits, including the ability to analyse information clearly and rationally ((Pearson 2017; Wulandari et al. 2021).

Rather simply trusting the arguments and conclusions provided, a person with strong critical thinking will challenge and seek to understand the facts presented (Bissonnette, Chastenay & Francoeur 2021).

They'll look for logical links between concepts, evaluate the eloquence of the arguments presented, and evaluate different interpretations of evidence. Critical thinking skills can help a person overcome these challenges and differentiate between facts and opinions (Paul & Elder 2020). The Watson Glaser critical thinking test, which is utilized in this study to measure high school students' critical thinking abilities, is based on the RED model of critical thinking (see Figure 3).

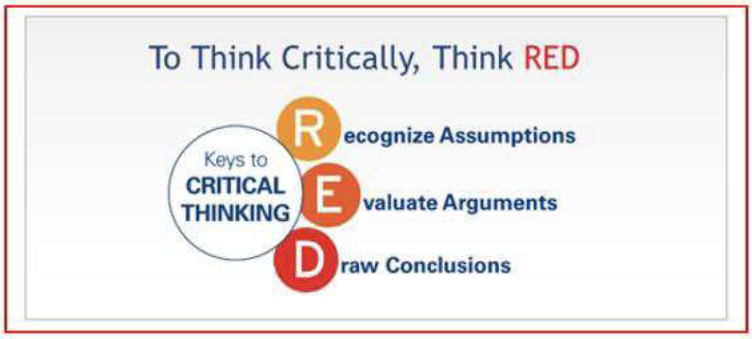


Figure 3: RED Model Framework
Adopted from: Pearson (2017)

The "RED Model,"is an organizing framework to enhance learning, and it is used to organize critical thinking process into:

a- Recognize Assumptions: It's all too easy to listen to a comment or a presentation and believe the information is right, even if there's no evidence to back it up.

Observing and questioning assumptions can help you spot information gaps and erroneous thinking.

We must also examine assumptions from a variety of angles (Pearson 2017; Watson & Glaser 2019).

b- Assess Arguments: The skill of assessing arguments includes critically and correctly examining material, challenging the quality of supporting evidence, and recognizing how emotion influences the topic. A tendency to prioritize information that confirms an existing point of view or allowing emotions to get in the way of objective judgment are both common barriers (Pearson 2017; Wulandari & Hindrayani 2021).

c- Draw Conclusions: It's vital to pull together a variety of data while making a decision in order to arrive at conclusions that logically flow from the evidence.

People that are capable of doing this are careful not to extrapolate beyond the evidence and are willing to change their ideas if the evidence warrants it. "Sound judgment" is commonly used to describe them. 2021) (Wulandari & Hindrayani).

The RED Model features six fundamental questions, according to Pearson (2017), that can be utilized to stimulate and develop critical thinking skills.

The critical thinking framework of the RED Model divides the model's fundamental issues into three categories (see Table 1).The core question of this RED model is thought to be able to assist in the development of thinking skills, particularly critical thinking skills.

Table 1: Key "RED" Questions to Consider When Problem Solving
Adopted from: Wulandari, R. & Hindrayani, A. (2021)

2.5 Paulian Theory

The Paulian paradigm, or Paulian critical thinking, arose from Paul's attempt to specify the minimum conditions for an acceptable theory of critical thinking and then expand upon those circumstances (Ku, Lee, & Ellis 2017). Paul attempted to weave together and synthesize a web of seemingly self-evident truths about critical thinking and the various impediments to it.

It was founded on the following concepts (Paul & Elder 2019, 2020): 1) Thinking is in our nature, and it pervades every aspect of human existence and cognition. 2) Even if thinking is in our DNA, it is not in our DNA to think well. Bias, illusion, mythology, ignorance, and self-deception all have a strong influence on human nature. 3) As a result, we must be able to intervene in thinking, investigate, assess, and improve it as needed.

While contemplating and developing his notion of critical thinking, Paul realized that some intellectual capacities cannot be completely separated from intellectual traits in the mind of the critical thinker (Tebbs 2017). Individuals who can empathically explore opposing opinions,

accurately convey those viewpoints, and credit them for their insights, for example, have a level of intellectual command that others do not. To summarize his early work, Paul conceptualized and developed four conceptual sets, each of which is an integrated system of meanings that inherently interacts with the other two and, when combined, provides the most comprehensive model of critical thinking currently available to those interested in understanding thinking, what it entails, how it should be assessed, and how it should be oriented (Ku, Lee & Ellis 2017). The elements of reasoning, or mental structures, are the belief that all reasoning is made up of pieces, and that these pieces can be used to study thinking, any thinking, in order to better understand it (Paul & Elder 2019, 2020). According to Paul, thinking aids in the development of the following elements (see Figure 4):

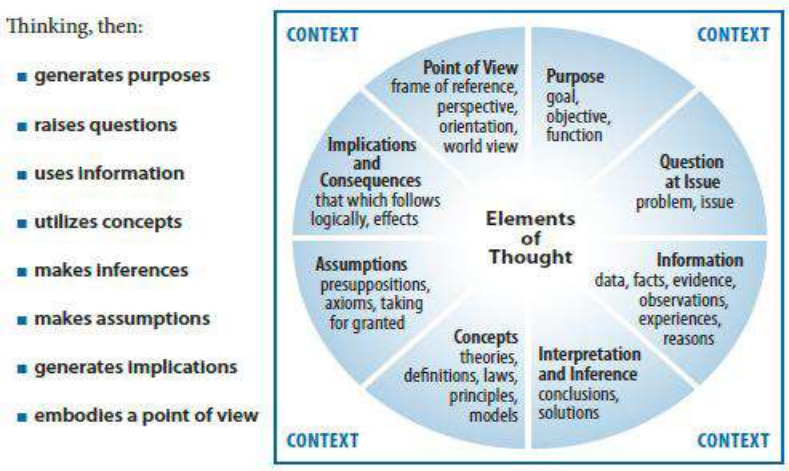


Figure 4: Elements of Thoughts
Adopted from: Paul, R. & Elder, L. (2019)

2.6 Bloom's Taxonomy Theory of Learning

Bloom's taxonomy begins with knowledge or memory and progresses via a series of questions and keywords that encourage the learner to act. For education and meta-cognition, which is the master level of thinking, both critical thinking and Bloom's taxonomy are essential (Wilson, 2016). Critical thinkers can examine their own reasoning, draw conclusions based on facts, and apply their understanding of a concept in a variety of ways. They have the ability to rephrase questions, break down tasks into smaller bits, apply data, and generate new data (Rahman & Manaf 2017).

This is a set of skills that can be taught and learned (Arievitch, 2020). According to Bloom's taxonomy, learners use six cognitive domains to acquire, retain, and use new information:

knowledge, comprehension, application, analysis, synthesis, and assessment (Billings, DeRuchie, Haist 2016; Rahman & Manaf 2017). This cognitive hierarchy (see Figure 5) is based on the premise that children must first master lower-level skills like recall and understanding before learning higher-order skills like synthesis and evaluation (Billings, DeRuchie, Haist 2016; Zaidi et al. 2017).

Higher-order thinking skills that span Bloom's taxonomy levels are required in the complex and nuanced world of clinical practice (Zaidi et al. 2017).

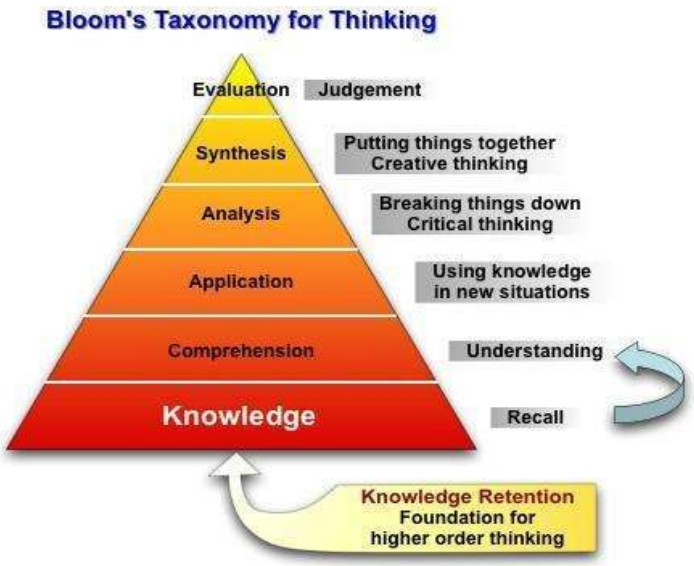


Figure 5: Interconnection between Critical Thinking and Bloom's Taxonomy
(Adopted from: https://bcc-cuny.libguides.com/c.php?g=824903&p=5897590)

While Bloom's framework was created to aid in the creation and implementation of curriculum, It's also been used to help inform and steer evaluations (Zaidi et al. 2017). Bloom's taxonomy has been used to identify MCQs that assess students' critical thinking skills, with research indicating that higher-order MCQs assist students better understand scientific process skills (Billings, DeRuchie, Haist 2016). This perspective is supported by the National Board of Medical Examiners' item writing guide, which suggests that foundational scientific and clinical MCQs begin with a narrative that contextualizes a topic and encourages participants to identify relevant facts. This is then used to evaluate higher-order cognitive processes (Billings, DeRuchie, Haist 2016; Zaidi et al. 2017). The W-GCTA test used in the current study is built on the same framework.

LITERATURE REVIEW

This section of the research focuses on establishing the link between variables of the research objective, as well as shedding the light on the importance of critical thinking skills CTS in K-12 education which has sparked many studies into how to improve students' skills. The majority of these studies focus on teacher-related variables, student-related variables, or institution-related variables. As a result, the following section of this research review is organized around the importance of developing critical thinking skills of students, factors that may influence this development, teaching strategies that are useful in fostering critical thinking skills and commonly used tools used for critical thinking assessment.

2.7 The Importance of Critical Thinking Skills

In a world where immediate access to information, sophisticated jobs, and biased media are all concerns that must be addressed, critical thinking is more crucial than ever (Al-Zou'bi 2021). As a result, via education, students should be given the tools they need to become engaged, responsible, and involved citizens. After all, well-prepared students have the opportunity to make a difference in the world (OECD 2018).

Such students have the ability to have a good impact on their surroundings, shape the future, understand the intentions, behaviors, and feelings of others, and predict the short- and long-term consequences of their actions (OECD 2018). Students will face unknown and changing circumstances later in life, necessitating a wide range of skills, including cognitive and metacognitive skills, for example critical thinking, self-regulation; social and emotional skills such as empathy, cooperation; and practical and physical skills. These abilities should be heavily emphasized in k-12 educational institutions (OECD 2018). In k-12 educational institutions, these qualities should be actively stressed (OECD 2018). Being literate in the media age involves critical

thinking skills that allow students to make informed decisions in the classroom, living room, workplace, and voting booth (UNESCO-IBE 2013; Lombardi et al. 2021). According to the European Union's Paris Declaration, "strengthening children's and young people's ability to think critically and exercise judgment so that they can grasp truth, differentiate fact from opinion, detect propaganda, and reject all sorts of brainwashing and hate speech" (CEU 2021).

Critical thinking, according to the Council of Europe (CoE 2016) entails the ability to analyze and make decisions about any type of content. Students who learn to think critically will be able to evaluate new knowledge and ideas, as well as other perspectives and ways of living, to determine whether they are acceptable or desirable (Lee 2018). Because critical thinking ability develops with age, relevant authors (Lombardi et al. 2021) evaluated the research literature and found that teaching critical thinking can benefit young children as well as older children. Other related research (Lombardi et al. 2021) showed that teaching critical thinking to young children improves their ability to ask questions, make hypothetical recommendations, and engage in reasoned thinking through peer group interaction. As a result, empirical data supports the idea that young children are capable of critical thinking (Gelerstein et al. 2016). In the twenty-first century, many K-12 educational institutions are responding to the challenge and responsibility of improving students' critical thinking skills across the curriculum (Lamb et al. 2017). Furthermore, school systems may play a vital role in equipping students with the skills they need to become active community members and critical thinkers (Lamb et al. 2017).

Despite the fact that increasing students' critical thinking skills is commonly acknowledged as an important educational goal, recent studies (Fuad et al. 2017; Haber 2020), claim that K-12 students' CT skills are poor. In a study conducted by (Didi and Sri 2021) high school students' critical thinking skills were assessed using W-GCTA, findings revealed that students' CT skills were in the poor category. This could be attributed to students tend to be given little instruction in formal education, particularly in K-12 schools, to analyze, process, and critically reflect on material (Ab Kadir 2017), as well as teachers' persistent lack of critical thinking skills, education, and training (McLaren 2015). The emphasis in school curricula is frequently on what to think rather than how to think (Forwai 2020). This transformation will necessitate a shift in thinking about instructional paradigms, public investments, and legislative reforms throughout education curriculum (Forawi 2020).

One of the UAE's main difficulties is ensuring that its educational system equips students with the skills that the country's expanding private sector requires, hence assisting industrial diversification and correcting the country's manpower population imbalance. The circumstances underscore the importance for the government to have a highly skilled Emirati workforce with a wide range of skill sets in an innovative economy (Forawi, 2020). As a result, pupils' critical thinking skills should be practiced as soon as possible.

Junior high school students, with an average age of 11-13 years, are in the concrete operational cognitive stage, according to Piaget's (1927-1980) cognitive development theory. Children of that age have been able to detect tangible objects using their cognitive skills, but have not been able to distinguish abstract objects, according to the theory (Allen & Kelly 2015).

As a result, students as young as high school might begin to build critical thinking skills (Rymanowicz 2016; Haber 2020).

The UAE's educational system has been chastised for focusing solely on rote memory learning. National students have incredible memorizing skills. Courses are being established to increase students' critical thinking skills at the K-12 and university levels. Effective measurement tools are required for any process improvement. The current critical thinking aptitude research study uses WGCT evaluation to examine the existing critical thinking abilities of high school students in a private school in Dubai, in order to promote areas of strength and improve areas that require improvement.

2.8 Factors Affecting Critical Thinking Skills Development

2.8.1 Students Related Factors

Students arrive at college with a diverse set of features and experiences. As a result, it's not surprising that a range of student characteristics have been discovered to influence CTS in the literature. As shown in the previous sections, there is little consensus on what elements help students acquire critical thinking skills in schools. For example, the relationship between gender and critical thinking is not thoroughly investigated. According to the literature, the links between gender and critical thinking are yet to be established (Shubina and Kulakli 2019). According to a study on critical thinking ability (Zetriuslita et al. 2016), gender differences are substantial at high levels of critical thinking abilities capacity, but not at moderate or low levels. Other studies found

no differences between males and females on critical thinking scales of inference and deduction, which agreed with Halpern's study (Bagheri and Ghanizadah 2016; Youssef 2021), which suggested that critical thinking might be fostered through experience or the transfer of knowledge to others. However, after testing 945 students (47.2 percent men, 52.8 percent females), Facione (2005) discovered that males acquire CTS faster than girls. Another study analyzed data from 3331 college students from 18 institutions and found that females scored higher than males on a critical thinking assessment at the end of their third year in school, even after controlling for college characteristics (Zetriuslita, Ariawan, & Nufus 2016). In contrast to these findings, Marni et al. (2020) found that boys and females had similar levels of CTS at admission and that this parity remained throughout their higher education travels. Perdana (2019) revealed no significant differences in CTS scores between boys and girls students. There was no difference in CTS scores between the two genders for nursing students, according to Yip and Tsui (2021).

In the literature on CTS, parental education has also been mentioned and scholars are in agreement about the effects of parental education (Kena et al. 2014; Andersson and Malmberg 2018; Perez 2019) .Parental education, according to Andersson and Malmberg (2018), is a pattern of persistent inequality in K-12 education. In addition, Kena et al. (2014) found that parents' educational levels were associated with their children's cognitive progress (including CTS) in schools (Perez 2019).

2.8.2 Teachers Readiness

Despite the fact that teachers may teach CTS in the classroom, they do not understand its meaning (Perez 2019). Teachers consistently endorse teaching CTS as the most important goal of undergraduate education (Huber & Kuncel, 2016); and, in general, believe they are teaching CTS to their students (Huber & Kuncel, 2016). Teachers, on the other hand, have encountered difficulties ranging from pedagogy to politics (Perez 2019). According to Ballakrishnan & Mohamad (2020), only a few teachers are qualified to teach and apply high-level thinking in the classroom, hence they are unable to teach CTS to students. Petrone (2018) believes that instructors are "ill-equipped" in this sense since critical thinking is not a talent that can be taught in the same way as other academic topics. Teachers, according to (Terada 2019), should not be faulted for this scenario because they are obligated to educate using a traditional method that views teachers as information providers and students as passive recipients of knowledge.

2.8.3 Institutions Related Factors

While there are some contradictory findings addressing the effects of teacher and student-related factors on critical thinking advances, researchers believe that school attendance aids cognitive development, including CTS (Trude & Magne 2021). Student-teacher contact, service involvement and diversity engagement (Perez 2019) are all thought to be driving factors promoting CTS increases in school students. According to researchers (Cuyjet et al. 2016; Perez 2019), these institutional characteristics can be reasonably linked to CTS advances. As a result, data suggests that what happens to students on campuses has a greater impact on their learning and change than the structural qualities of the institutions they attend (Terada 2019).

2.9 CT Teaching Strategies & Instructional Instruments

The increased demand for students to develop critical thinking abilities in K-12 educational institutions has led to the creation of a variety of instructional interventions as well as a variety of methodologies for evaluating the efficacy of these interventions (Forawi 2020). According to various studies, the most successful teaching happens when students' critical thinking skills are actively taught and cultivated throughout their academic careers (Haber 2020). Pedagogical tools for teaching critical thinking in K-12 education include writing exercises, inquiry-based projects, flipped lectures, open-ended practicals, and gamification (Danczak, 2018). Students' knowledge is shaped by their learning experiences, which are linked to their developmental stage as well as environmental influences (Perez 2019). Connecting past understandings with new findings is one method for learning success.

This is what the constructivist method is all about: focusing on the pupils, fostering creative thinking, and assisting them in reaching their full potential (Yezierski, 2018).

The following are some proposed ways for assisting students in developing critical thinking skills:

2.9.1 Cooperative/Collaborative Learning Strategies (CLS):

Cooperative Learning is a set of teaching/learning approaches in which students work together to acquire and practice subject matter aspects and achieve common learning objectives. It entails much more than simply grouping students and hoping for the best (Idi et al. 2021). These strategies necessitate greater teacher control. Students are asked to discuss a specific topic or participate in brainstorming exercises. Cooperative Learning is a very formal manner of organizing activities in a learning environment that contains specific features aimed at increasing the participants' ability

to learn richly and deeply. Examples of these strategies: Think-Pair-Share, Circle-the-Sage, Timed-Pair-Share, Agree-Disagree Line-ups and Rally Coach (Macpherson 2019).

CLS have a favorable and considerable influence on learners' critical thinking skills, according to the data of a study conducted by Idi et al. (2021). CLS also assisted them in maintaining their critical thinking abilities. As a result, the students said CLS helped them with emotional awareness, learning motivation, cognitive development, and broad-mindedness. Based on the existing findings, additional research can be conducted to establish a theoretical CLS model that includes critical thinking, learning motivation, cognitive growth, and social competence (Idi et al. 2021).

2.9.2 Guided Inquiry Learning Technique

The guided inquiry learning methodology is a tool for teaching students how to practice problem-solving abilities (Nisa et al., 2018). This paradigm has been shown to be successful in training and guiding students in their ability to build higher-order thinking patterns as well as their grasp of concrete things (Seranica et al., 2018). Students will learn how to research and explain events through inquiry-based learning, formulation of the problem, formulation of hypotheses, data collection, hypothesis testing, and formulation of conclusions are the guided inquiry learning phases (Putra et al., 2018), which correspond to the CT components to be measured in this study (see Table 2). (Hasan and Pri, 2020).

No	Stage of Guided Inquiry	Description	HOTS activities	Aspects of HOTS
1	Presenting the problems	At this stage, a phenomenon is presented so that the students' desire to ask questions and formulate problems arises		
2	Arranging hypothesis	Students make hypotheses that are relevant to the problem and decide hypotheses that will be used as a priority research	Analyzing	Critical thinking skill
3	Investigating and collecting data	Determine and carry out experiment steps and collect data		
4	Analyzing the data	Students process data that has been collected and test hypotheses that have been formulated previously	Evaluating	
5	Reflection or conclusion	Students decide, predict, interpret and explain by making conclusions based on the data analysis	Creating	Creative thinking skill

Table 2: The Relation between Guided Inquiry Stages and CT Skills
(Adopted from: Hasan, M. & Pri, S. (2020), p. 4)

2.10 Critical Thinking Assessment

In this period of 21st-century skills, the focus of education has switched from quantity to quality (Rashel & Kinya 2021). Most countries have already met their access to education goals and are now focusing on quality (Shimuzu 2021). During this competitive period, their concentration has shifted from lower-order thinking skills to higher-order thinking skills. Critical Thinking Skills or CTS are a type of higher-order thinking skill, and research into how to measure them is rapidly expanding. The majority of CT skills research concentrates on general CT abilities rather than domain-specific CT skills. Students' CT skills are still in the poor category, according to some research findings from throughout the world (Fadhlullah et al. 2017; OECD, 2019; Haber, 2020). Because there are numerous objectives to be reached, critical thinking assessment is crucial, especially in K-12 education. According to Ennis, the value of critical thinking assessment is diagnosing students' CT skills, offering critical thinking feedback to students, motivating students to enhance their critical thinking, and providing educators with feedback about the impact of their interventions on students' critical thinking as well as the appropriate teaching strategies for teaching students CT skills (Facione 2015; Danczak 2018; Hidayati, 2019; Rashel & Shimuzu 2021). The main topic of contention in CTS evaluation is whether it is best taught in general or specialist subjects such as history, medicine, law, and education.

Critical thinking has long been thought of as a universal, all-encompassing talent that 'generalists' can apply to any teaching method (Danczak 2018; Rashel & Shimuzu 2021). On the other hand, it is seen as a skill exclusive to a specific context and expertise by the ‘specialists’ (Danczak 2018; Rashel & Shimuzu 2021). The debate over this long-running topic is essential for understanding the nature of the human mind; nevertheless, taking sides is not obligatory (Huber & Kuncel, 2016; Danczak 2018). The idea of combining the two methodologies has gotten a lot of good response. The researchers recommend teaching students' multifaceted critical thinking' as well as the concept of CT, which is similar to what the 'infusion' pioneers advocated (Hidayati & Sinaga 2019).

There are certain important aspects to make while developing and using a critical thinking test. To begin with, different sources of literature agree that critical thinking measurement should be tightly aligned with the intervention(s) being tested (Carter et al. 2015; O'Hare and McGuinness, 2015; Danczak 2018). Few empirical research that employed the WGCTA(-S) or the CCTST, for example, provided an explanation for why they chose the test (Danczak 2018). According to Ennis (2019), an operational definition of critical thinking must be established so that the assessment is

tailored to the investigator's perspective on critical thinking. Ennis goes on to explain that no single critical thinking assessment can serve all of these needs at the same time, and that the investigator must choose whether to use a commercially available test or a non-standardized evaluation (Danczak 2018).

Learners, policy makers, and employers all recognize that developing critical thinking skills is not only beneficial in and of itself, but also better prepares students to meet and exceed employer expectations in entry level jobs when making decisions, solving problems, and reflecting on their own performance (Lindsay, 2015). As a result, governments, employers, and students have begun to expect K-12 educational institutions to foster critical thinking abilities in their students.

Despite the evident need to develop students' critical thinking abilities, assessing their talents is challenging and rarely done in a meaningful way. The best approaches for teaching and measuring student critical thinking, as well as how students, academics, and companies interpret critical thinking, are constantly debated (Danczak 2018).

To evaluate student development of critical thinking and/or teaching interventions designed to develop critical thinking, many researchers use validated commercially available tests such as the Californian Critical Thinking Skills Test (CCTST), the Cornell Critical Thinking Test (CCTT), the Critical Thinking Assessment Task (CAT), or the Watson-Glaser Critical Thinking Appraisal (WGCTA) (Danczak 2018). Several recent reviews have shown that these commercially available tests can be used for a variety of purposes, including pre- and post-teaching intervention testing, as well as cross-sectional and longitudinal studies (Carter et al. 2015; O'Hare & McGuinness, 2015; Huber & Kuncel, 2016; Danczak 2018).

Table 3 below lists the tests that were created by well-known academics in the domains of education and/or psychology, followed by a brief explanation of each test. These tests have usually passed reliability and validity tests with thousands of people, and they've been changed and updated throughout time (Danczak 2018). While this list does not include all the tests, it does highlight the tests that have been most frequently reported in the literature.

Test	Question structure	Critical thinking skills assessed
CCTST (Insight Assessment, 2013)	40 item multiple choice questions	analysis, evaluation, inference, deduction and induction
WCGTA (TalentLens, 2017)	85 item multiple choice questions	inference, deduction, drawing conclusions, making assumptions and assessing arguments
WGCTA-S (Pearson, 2015)	40 item multiple choice questions	inference, deduction, drawing conclusions, making assumptions and assessing arguments
CCTT-Z (The Critical Thinking Co., 2017)	52 item multiple choice questions	induction, deduction, credibility, identification of assumption, semantics, definition and prediction in planning experiments
EWCTET (Ennis and Weir, 1985a)	Eight paragraphs which are letters containing errors in critical thinking and essay in response to these paragraphs.	understanding the point, seeing reasons and assumptions, stating one's point, offering good reasons, seeing other possibilities and responding appropriately and/or avoiding poor argument structure

Table 3: Summary of Commonly Used Commercially Available Critical Thinking Tests
Adopted from: Danczak, S. (2018)

Facione was the first developer of the California Critical Thinking Skills Test (CCTST). It's a 40-item multiple-choice test that measures your ability to analyze, evaluate, infer, deduce, and infer (Insight Assessment, 2017). This test is the most common kind of evaluation when searching the recent literature for critical thinking assessment (Facione 2015; Danczak 2018; Rashel & Shimuzu 2021).

Another multiple-choice test is the Cornell Critical Thinking Test Level Z (CCTT-Z). It is arguably the third most prevalent exam utilized by researchers when evaluating their students' critical thinking, coauthored by Robert Ennis and Jason Millman (The Critical Thinking Co., 2017). It is a 52-item test that assesses induction, deduction, credibility, assumption identification, semantics, definition, and prediction. A manual containing norms, validity, reliability, and item analysis is available to assist with its administration. (Ennis & Millman 2017; Perez 2019).

Robert Ennis and Eric Weir created the Ennis-Weir Critical Thinking Essay Test (EWCTET) (Danczak 2018; Hollis et al. 2020). It includes skills like ‘understanding the point’, ‘seeing reasons and assumptions’, ‘stating one’s point’, ‘offering good reasons’, ‘seeing other possibilities’ and ‘responding appropriately and/or avoiding poor argument structure’. The test departs from other tests' deductive or formal logic in an attempt to put critical thinking in a real-world setting, allowing the participant to demonstrate critical thinking dispositions to some extent (Danczak 2018; Perez 2019; Hollis et al. 2020).

The Halpern Critical Thinking Assessment (HCTA) (Halpern 2016) was created by Diane Halpern and claims to be the only general domain critical thinking test to use a format that combines "forced choice" (which includes multiple choice, ranking, or rating alternatives) and "constructed response” (more akin to short answer responses). Reasoning, argument analysis, hypothesis testing,

likelihood and uncertainty analysis, decision making, and problem solving are all covered by the HCTA (Halpern 2016; Danczak 2018; Rashel & Kinya 2021).

2.11 The Watson-Glaser Critical Thinking Appraisal (W-CGTA)

By far the most common sort of critical thinking test is TalentLens' Watson-Glaser Critical Thinking Appraisal (W-GCTA). The Watson- Glaser Critical Thinking Appraisal, which has been in use for over 85 years, is the most extensively used test of critical thinking ability (Pearson 2017, 2018).

The W-GCTA is the most extensively used examination by law companies, which makes sense because the abilities examined are good predictors of future performance in professions that need clarity of understanding from various perspectives and the ability to reason with facts rather than preconceptions. The W-GCTA was invented by Goodwin Watson and Edward Glaser and it evaluates the critical talents needed to convey a point of view in a clear and concise manner and persuading others to agree with you ((Pearson 2017, 2018). It is a short, consistent, and accurate evaluation of the ability to: analyze, reason, intervene, and derive conclusions from textual data. It is one of the most established and renowned global exams. The test is appropriate for adults (16 and above) and has been changed and improved numerous times since its inception some decades ago (Pearson 2018).

Goodwin Watson and Edward M. Glaser initially released the Watson-Glaser Critical Thinking Appraisal in 1964, following a development period that began in 1926. It has since become the most widely used way of evaluating critical thinking around the world. It's available in French, English, Dutch, and Spanish, and it's used in Australia, Canada, India, France, Japan, the Netherlands, Mexico, Singapore, the United States, and the United Kingdom (Pearson 2020). The Watson-Glaser II Critical Thinking Appraisal, a new version of the test, was launched in 2010. This edition included customer-requested improvements as well as the introduction of the RED model. Watson-Glaser is now part of Pearson's TalentLens product suite. Thousands of companies and schools utilize Watson-Glaser, along with other TalentLens exams, to find exceptional managers, develop high-potential staff, and admit students to difficult programs (Perason 2020). The Watson-Glaser has a long and illustrious history, extending back to its inception in the 1920s

(see Chart 1), and it has undergone numerous adjustments and enhancements to guarantee that it remains a top critical thinking assessment tool today (Pearson 2020).

Chart 1: History and Reach of Watson-Glaser
Adopted from: Pearson (2020)

In the context of the current study, the modified version of the Watson Glaser Critical Thinking Appraisal W-GCTA test consisting of 40 questionsis used to measure the students' critical thinking aptitude in five main aspects of critical thinking as it is going to be discussed in the methodology chapter.

CHAPTER 3

METHODOLOGY

3.1 Research Approach

Research methodology is the manner by which researchers must conduct their studies. It shows how these researchers formulate their problem and objective, as well as how they present their conclusions based on the data gathered during the research period (Johnson 2014; Sileyew 2019).

The research design, on the other hand, is the overarching strategy for conducting research that gives a succinct and logical approach to handle a specific research issue in a logical and cohesive manner, through the gathering, interpretation, analysis, and discussion of data. It's a step-by-step guide to data collection, measurement, and analysis (Johnson 2014; Bloomfield & Fisher 2019; Sileyew 2019).

The current study is quantitative in nature. The rationale of the use of this approach is to gain a better understanding of the social world, and to observe situations or events that have an influence on people through the collection of numerical data (quantitative data), and the use of statistics, (Johnson 2014; Sileyew 2019; Bhandari 2020), in order to generate new new insights about a research study in a momentary, free-flowing sense (Bloomfield & Fisher 2019; Sileyew 2019). The quantitative research design used in this study is a descriptive case study. A case study is an analysis of a person, organization, or event that is both descriptive and exploratory, and establishes only associations between variables when subjects are generally measured only once. To achieve

a meaningful estimate of a generalized association between variables, the study may contain a sample population of hundreds or thousands of people.. More about the characteristics of the quantitative research design are listed in Table 4, which shows a comparison between the key features of quantitative and qualitative research adopted from Ahmad et al. (2019). Reflecting on the research question of the current case study, which focuses on examining high school students' critical thinking aptitude, The Watson-Glaser Critical Thinking Appraisal, or W-GCTA, is a quantitative data collection instrument based on students' test results. The test results are then analyzed using a specific technique called Item Response Theory (IRT), which is a mathematical model used to explain the relationship between latent traits (unobservable attributes) and manifestations (i.e. observed outcomes, or performance) (Deng & Bolt 2016), and to connect the qualities of items on an instrument, how people respond to them, and the underlying aspect being measured. (Baker & Kim 2017). In the context of the study, the basic idea of the W-GCTA, is that each response to the test item gives some indication of the individual's level of latent trait or critical thinking aptitude (Deng & Bolt 2016).

Basis for Comparison	Qualitative Research	Quantitative Research
Meaning	Qualitative research is a method of inquiry that develops understanding on human and social sciences, to find the way people think and feel.	Quantitative research is a research method that is used to generate numerical data and hard facts, by employing statistical, logical and mathematical technique.
Nature	Holistic	Particularistic
Approach	Subjective	Objective
Research type	Exploratory	Conclusive
Reasoning	Inductive	Deductive
Sampling	Purposive	
Data	Verbal	Measurable
Inquiry	Process-oriented	Result-oriented
Hypothesis	Generated	Tested
Elements of analysis	Words, pictures and objects	Numerical data
Objective	To explore and discover ideas used in the ongoing processes.	To examine cause and effect relationship between variables.
Methods	Non-structured techniques like In-depth interviews, group discussions etc.	Structured techniques such as surveys, questionnaires and observations.
Result	Develops initial understanding	Recommends final course of action

Table 4: Comparison between The Key Features of Quantitative and Qualitative Research
(Adopted from: Ahmad el al. 2019)

A research method or paradigm, on the other hand, refers to a group of researchers' shared worldview or viewpoint on research, which is founded on a set of shared assumptions, concepts, beliefs, and procedures (Johnson 2014; Sileyew 2019). Simply said, it is a way of thinking about and carrying out research (Johnson 2014; Sileyew 2019). The philosophy that underpins the current study is postpositivism, which is the study's paradigm. This ideology considers only "fact-based" information received through the use of the senses to monitor, including measurement, to be reliable (Bloomfield and Fisher 2019; Sileyew 2019; Maciejewski 2020). In the case study at hand, the W-GCTA test results are 'fact-based' measurements that were acquired and evaluated to objectively measure the critical thinking aptitude of students in grades 10 and 11., without any addressed intervention.

The researcher's participation in positivist studies is limited to acquiring data and objectively interpreting it (Johnson 2014; Sileyew 2019). The researcher assumes that there is a reality to be observed and that reasonable observers of the same event will agree on its existence and characteristics. When possible, the researcher strives to be as objective or value-free as possible, and to prevent human prejudice (Johnson 2014). In other words, the researcher operates as an unbiased analyst who separates himself or herself from personal biases when conducting research (Johnson 2014; Bloomfield & Fisher 2019; Sileyew 2019). In some ways, quantitative researchers aim to explore topics they're interested in "from afar." For example, standardized questionnaires and other quantitative measuring techniques are commonly used to precisely measure what is observed (Johnson 2014; Sileyew 2019).

3.2 Research Methods

The most frequent way for conducting a quantitative research is primary methods. The major feature of this method is that researchers concentrate solely on data collection (Johnson 2014; Sileyew 2019). They don't rely on the findings of a previous research study (Johnson 2014; Bloomfield & Fisher 2019; Sileyew 2019). In this study, the data is collected directly from the students’ results in the W-GCT Appraisal test which is constructed and modified by the researcher. The primary research method adopted by the current design is a non-experimental research method.

Nonexperimental research methods are a set of strategies for doing quantitative research in which no variables in the study are manipulated (Mertler 2021). In other words, variables are measured in their natural state, without any intervention from the researcher (Johnson 2014; Sileyew 2019). This lack of manipulation could be due to the fact that the variable was organically "manipulated" before the study began, or it could be due to the researcher's inability to manipulate a particular variable (Johnson 2014; Sileyew 2019; Mertler 2021).

Descriptive research (which includes observational and survey research), is the type of nonexperimental research methods used to fulfill the purpose of the current study. The aim of descriptive research is to identify and analyze the current situation of people, places, things, or events (Johnson 2014; Fielding, Lee, & Blank 2017; Sileyew 2019). The researcher in descriptive research merely observes the phenomenon of interest as it is; no attempt is made to modify the individuals, conditions, or occurrences (Mertler 2021). Two common quantitative, non-experimental descriptive research designs are observational research and survey research. Quantitative observational studies usually concentrate on a certain feature of behavior that may be measured in some way (Mertler 2021). It has the advantage of producing data that represent the complexity of human behavior. In the context of the study, the results of the W-GCT Appraisal test are used to reflect on the critical thinking aptitude of students, which is complicated to be represented.

3.2.1 Site

The private school, where the current study is conducted, is located in Dubai, UAE. It is a for-profit private independent institution. The American curriculum is used at this school, and English is the predominant language of instruction in Kindergarten through Grade 12 in order to satisfy the demands of Dubai's multi-national community. The school's educational framework incorporates the Massachusetts Common Core state standards. The school is coed until Grade 3, following which boys and girls are taught separately.

3.2.2 Study Population, Sample & Sampling Method

Reflecting on the purpose of the study and the research questions, the population of interest is high school students from the boys and girls' sections in a private school in Dubai. The study is

conducted on a sample of this 291-student population which is grades 10 and 11 students. The sample consists of 91 students, where 48 students are from the girls' section and 43 students are from the boys' section.

A sampling method is the method for obtaining the members of a sample (Johnson 2014; Casteel & Bridier 2021). Probability sampling refers to methods for constructing a sample based on known probabilities that allow judgments about the population of interest after analysis (Johnson 2014; Casteel & Bridier 2021).

The most common application of probability sampling is in quantitative research. This sampling technique is convenient for the purpose of the study, which is examining the critical thinking aptitude of grades 10 and 11 students in order to get some indication of the level of latent trait or critical thinking aptitude of the high school students in a private school in Dubai. The sample has a probabilistic representation of the population of interest since it is generated at random, with each member of the population having an equal chance of being selected (Etikan & Bala 2017). For the current study, the simple random sample is used to develop the sample, which is similar to drawing names which are grades 10 and 11 students from a hat which is 291 high school students.

3.3 Instrument

3.3.1. Overview of the Watson Glaser Critical Thinking Appraisal

In the context of this study, the W-GCT Appraisal test results of students are the measurement on which the study's outcomes rely on. To fulfill the research questions, the adapted or modified Watson Glaser Critical Thinking Appraisal or W-GCTA test (see Appendix 1) consists of 40 questions designed to assess a person's ability in five main aspects of critical thinking (see Table 5): 1. Make correct inferences, 2. To recognise assumptions, 3. To make deductions, 4. To come to conclusions and 5. To interpret and evaluate arguments ((Pearson 2017, 2018).

Name of the section	What does it measure?	How many questions?
1. Inference	Rates the probability of the truth of inferences based on the information given.	5-6 questions
2. Recognition of Assumptions	Identifies unstated assumptions underlying given statements.	12 questions
3. Deduction	Determines whether conclusions follow logically from given information.	5-6 questions
4. Interpretation	Decides if generalizations or conclusions based on data follow	5-6 questions

Table 5: Sections of W-GCT Appraisal Test
(Adopted from: https://www.iprep.online/courses/watson-glaser-test-wgcta-free/)

The following are the details of the W-GCT Appraisal test five sections:

1. Inferences: in this section, candidates will be given a passage of information about a situation in this section. Following that, applicants will be asked to judge whether the conclusions are true, false, possibly true, possibly false, or if it is impossible to say based on the facts in the paragraph (Pearson 2017, 2018; AssessmentDay 2022).

2. Recognition of Assumptions: in this section's questions, the applicant will be given a statement and asked to assess whether the statement was made on the basis of an assumption. In the expression "only people earning a high pay can afford a fast car," for example, it is predicted that fast cars will cost more than non-fast cars (this is just one of many assumptions implicit in the statement). When someone assumes anything, they are making an assumption. Individuals are given statements to read, followed by a slew of possible assumptions. The candidate must decide whether or not they have made an assumption (Pearson 2017, 2018; AssessmentDay 2022).

3. Deductions: Candidates will be given a passage of information and asked to assess a list of deductions based on it. If a particular proposition cannot be inferred from the passage, that deduction does not follow, then the candidate must decide which deductions should be followed and which should be avoided. The answer must be entirely based on the statements presented, not on inferences based on personal experience (Pearson 2017, 2018; AssessmentDay 2022).

4. Interpretation: in this section, a paragraph of information will be presented to the candidate, along with a list of possible conclusions. Candidates must evaluate the paragraph's content and

determine if each conclusion is supported by the evidence. Again, decisions must be made solely on the basis of the data available. A series of inferences will follow a passage of information. All of the information in the passage must be assumed to be correct by the candidate. The goal is to analyze whether each of the proposed conclusions follows logically from the facts supplied in the paragraph. Candidates should only use the information presented in the passage while answering questions (Pearson 2017, 2018; AssessmentDay 2022).

5- Evaluation of Arguments: in this part of the test, candidates will be given a scenario to think about, such as "Should the government pay for student tuition fees?" They are then given a list of pro and con arguments for the situation that is being presented. Based on its relevance and efficacy in answering the question, the applicant must assess if each argument is strong or weak. The argument is considered strong if it is directly related to the question or statement; it is considered weak if it is not directly related to the question or statement (Pearson 2017, 2018; AssessmentDay 2022).

3.3.2. Watson-Glaser Validity & Reliability

Since the beginning of work on Watson-first Glaser's edition in the 1920s, the assessment of the W-GCT Appraisal has been thoroughly investigated. Validity, reliability, and fairness are three Assessment Quality Indicators (AQIs) that have been used to measure the efficacy of Watson-Glaser assessments (Pearson 2020). Positive correlations of 0.16 to 0.58 have been found in studies comparing Watson-Glaser scores to a number of on-the-job performance metrics, implying that test-takers who do well on the Watson-Glaser are likely to do well at work (Watson & Glaser 2019; Pearson 2020). Watson-Glaser scores have also been compared to final course grades in a business degree and the Bar Professional Training School, a post-graduate vocational training school for aspiring barristers in England and Wales.. These studies reported correlations ranging from 0.38 to 0.62, implying that Watson-Glaser is an excellent predictor of likely course success (Watson & Glaser 2019). Table 6 below shows these relationships with final course grades, as well as correlations with other academic performance markers.

Table 6: History and Reach of Watson-Glaser
Adopted from: Pearson (2020)

In addition, studies on the previous versions of Watson-Glaser have placed its internal consistency between 0.75 to 0.86 (sufficient to good) and a standard error of measurement SEM of 0.32 to 3.6 (Watson & Glaser 2019). Furthermore, two tests in the United Kingdom, one with 355 participants and the other with 318, yielded correlations of 0.82 and 0.88, respectively, indicating strong alternate form reliability (Watson & Glaser 2019; Pearson 2020).

3.4 Analysis

3.4.1 Three Scoring Scales – The RED Model

The test results are reported using a three-scale paradigm called the RED Model of critical thinking: (R) Recognition of Assumptions: this scale is purely based on the same-named second segment of the test. It indicates how sensitive you are to information assumptions and presuppositions. (E) Evaluating Arguments: this scale is primarily based on the test's fifth section, which also goes by the same name. And finally, (D) Drawing Conclusions: This scale is based on three sorts of questions—inference, deduction, and interpretation—all of which deal with the art of drawing conclusions from data. It is a well-known scale, with 16 questions rather than the previous two scales' 12 questions ((Deng & Bolt 2016; Baker & Kim 2017; Pearson 2017).

3.4.2 Norms & Scoring

Norms are scores determined from a certain group of test takers, such as managers. When a test taker's result is compared to a relevant norm, it provides more useful information than just their

raw number. Raw scores can be used to rank test takers, but they can't tell you anything else. As a result of Watson-Glaser, administrators can compare an individual test-raw taker's score to a large group of individuals who completed the same test. The sample is referred to as a normative group, and the score produced from their performance is referred to as a norm. The normative group for the context of this study was picked from the list of norm groups constructed by Pearson, which is updated and added to frequently (Pearson 2020). The bar below (Figure 6) depicts overall performance on the W-GCTA in comparison to those who have previously completed the test in the chosen norm group for students (Pearson 2017).

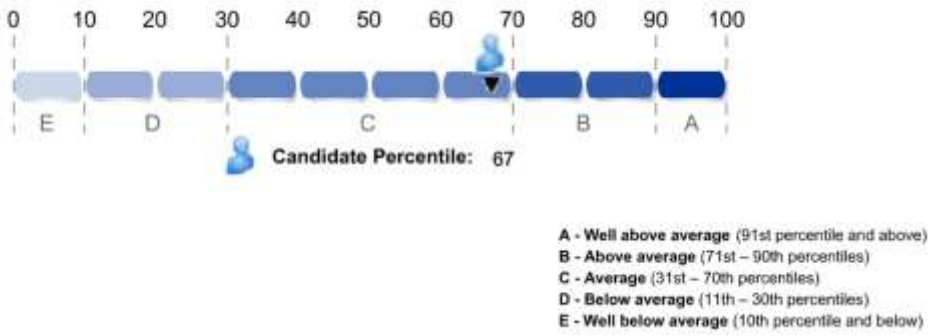


Figure 6: Overall Performance on the W-GCTA
(Adopted from: Pearson 2017)

3.5 Ethics

Since the current case study involves participants aged 16-18, it is necessary to obtain a written informed consent from the institution representative as well as a formal consent for parental/gatekeeper knowledge and approval (Johnson 2014; Sileyew 2019; Mertler 2021).

Prior to conducting the study, a third-party consent signed by the school principal as well as a guardian consent form addressed to the parents (see Appendix 2) have been obtained. The informed consent for the parents was created using Google forms using the researcher work email upon the approval of the third-party (the school principal), and sent via email to the designated students'

parents school emails, since the school has created email for each parent to access the school website and facilitate communication whom their children was chosen for the study, in order facilitate the collection of their approval (see Appendix 3).

In both consents, a descriptive brief introduction to the purpose of the study were demonstrated. Parents have been acknowledged that their decision on their children to participate in this study is completely voluntary, and if they decide to not allow their kids to participate, or to withdraw from participation at any time, it will not affect the care, services, or benefits to which their children are entitled. Moreover, parents were informed that their kids' responses to the test are completely anonymous, and no names or other identifying information will be used when discussing or reporting data. In addition, prior to the test, all students have been acknowledged with an informed consent about the purpose of the study and their approval on voluntary participation (see Appendix 4). To further ensure the confidentiality of data, achieving the purpose of this study does not require sharing any information that can lead to the students' identity or school information. Moreover, discussing the test results is only reflecting on the scores of each aspect of the critical thinking that has been evaluated in the test. No discussion is needed for the personal results of each student.

CHAPTER 4

DATA ANALYSIS & RESULTS

In this chapter, the results of statistical data analysis are presented. The chapter begins with a descriptive analysis section, where frequencies and percentages of correct answers for each section and its questions are presented. The second section is concerned with testing high school students' performance in terms of their percentile scores for norms, section performance, and demographic differences. Norms and scoring analysis were done by conducting one-sample t tests, section analysis was done by conducting one-way repeated-measures ANOVA, while independent-samples t tests were used to test demographic differences. As the main purpose of the current study is to answer these two research questions: (1) What critical thinking aptitudes do high school students in a private school in Dubai have as measured by the W-GCTA test? and (2) Are there any demographic differences among high school students regarding their critical thinking aptitudes as measured by the W-GCTA test? The results of the one-sample t tests and the repeated-measures ANOVA were used to answer the first question, while the independent-samples t tests results were used to answer the second question. The statistical software IBM SPSS Statistics 28 was used to

do the data handling and analysis. For statistical significance, the significance level was set at $\alpha = 0.05$.

4.1 Descriptive Analysis

Participating students' responses are summarized in

Figure 7: Students' Incorrect vs. Correct Answers for all Categories

Table , presented as frequencies and percentages (in parentheses) for a total of 49 girls and 42 boys; i.e., 91 high school students. The table summarizes students' responses for all PISA Skills Practice sections and statement questions, with totals computed for each statement under each section, and for each section of the practice, and an overall total is presented on the top of the table. Overall, we can say that students' have 68.6% of their answers are correct, while 31.4% are incorrect, indicating an overall high aptitude for correct answer versus incorrect. This indicated that participating high school students have high critical thinking aptitude as measured by Arguments as students have answered 76.3% correctly, Deductions as they have answered 73.2% correctly, Interpreting Information as they have answered 71.6% correctly, and Assumptions as

they have answered 65.8% correctly. On the other hand, students did not show high aptitude for correct answers in Inferences, as they have answered 48.4% correctly, while 51.6% incorrectly. These results can be graphically illustrated in

Figure .

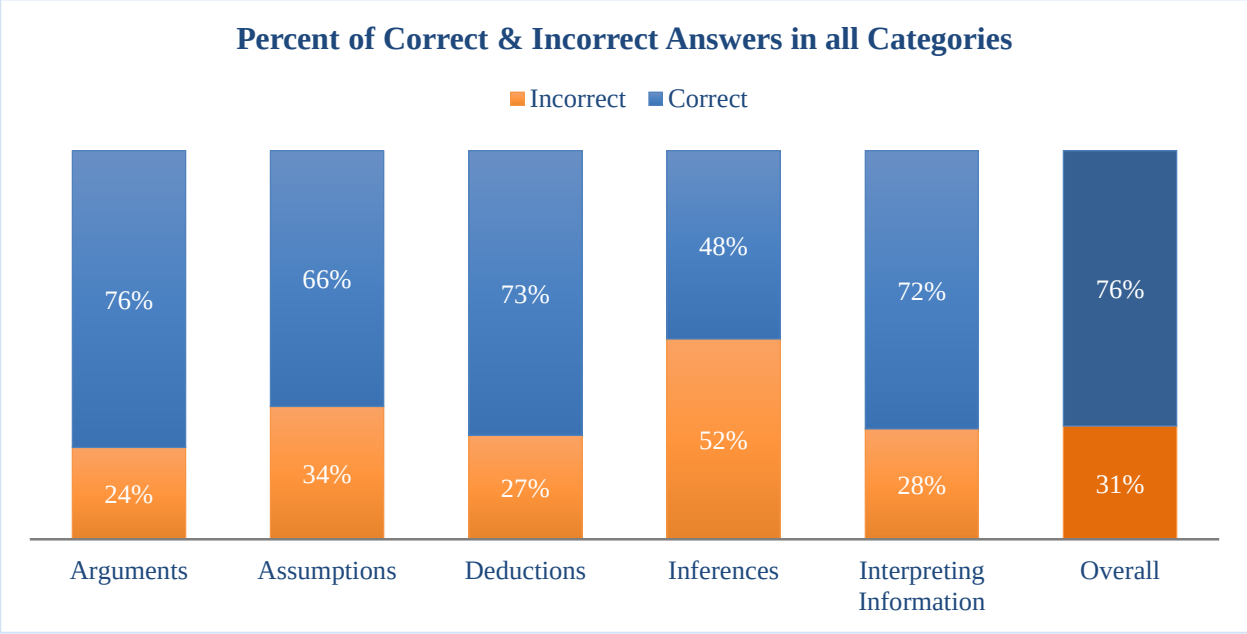


Figure 7: Students' Incorrect vs. Correct Answers for all Categories

Table 7. Frequencies and Percentages of Correct/Incorrect Responses [N=91]

Section, Statement, Item	Incorrect	Correct
Overall	**1144 (31.4)**	**2496 (68.6)**
Section 1: Arguments	**259 (23.7)**	**833 (76.3)**
Statement 1: Should university-level education be free to all students?	*52 (19.0)*	*221 (81.0)*
Q1. No, too much education can lead to over-qualification, and therefore unemployment.	14 (15.4)	77 (84.6)
Q2. Yes, having a highly qualified workforce ensures high levels of employee productivity in organizations.	17 (18.7)	74 (81.3)

Section, Statement, Item	Incorrect	Correct
Q3. No, research has shown that students that are not required to pay tuition fees tend to slack off more and learn less during their degree.	21 (23.1)	70 (76.9)
Statement 2: Should employers allow all staff the option of flexi-time working hours?	*63 (23.1)*	*210 (76.9)*
Q4. Yes, giving greater flexibility will improve their work-life balance, and therefore their productivity.	12 (13.2)	79 (86.8)
Q5. Yes, organization that value their staff are on average more productive and show lower staff turnover.	33 (36.3)	58 (63.7)
Q6. No, flexi-time leads to employees working fewer hours. Working fewer hours will decrease an employee's exposure to the workplace, making career progression harder and leading to a less experienced workforce.	18 (19.8)	73 (80.2)
Statement 3: Should all members of the European Union join the Eurozone and adopt the euro?	*99 (27.2)*	*265 (72.8)*
Q7. No, countries may find it difficult to adapt to a new currency.	29 (31.9)	62 (68.1)
Q8. Yes, the function of the European Union is to form a single currency union.	32 (35.2)	59 (64.8)
Q9. Yes, greater economic unity between countries improves foreign relations between those member countries, which in turn make each country stronger.	12 (13.2)	79 (86.8)
Q10. No, instability of one Eurozone country could cause the whole Eurozone to become unstable, disrupting the economies of all countries that use the	26 (28.6)	65 (71.4)
Statement 4: Should governments be engaging in space exploration research?	*45 (24.7)*	*137 (75.3)*
Q11. No, the money spend on these programmes could be used to increase funding for education and healthcare, which would lead to increasing the quality of life for a country's people.	17 (18.7)	74 (81.3)
Q12. No, countries have collectively spent trillions of dollars on space exploration research already.	28 (30.8)	63 (69.2)
Section 2: Assumptions	**373 (34.2)**	**719 (65.8)**
Statement 1: In 2008, the President of the USA promised to prevent the country entering economic depression, but he failed because at the beginning of 2012, over 12 million USA citizens were unemployed.	*86 (31.5)*	*187 (68.5)*
Q13. Unemployment is an indicator of economic depression.	15 (16.5)	76 (83.5)
Q14. The number of USA citizens out of work ought to be less than 12 million.	35 (38.5)	56 (61.5)
Q15. Presidents should stick to their promises.	36 (39.6)	55 (60.4)
Statement 2: Chilean students were right in 2012 to stage protests demanding that university education in Chile should be made free.	*144 (39.6)*	*220 (60.4)*
Q16. Some Universities outside of Chile are free.	27 (29.7)	64 (70.3)
Q17. Chilean students cannot afford to pay fees for university education.	39 (42.9)	52 (57.1)
Q18. Chilean students want to attend university.	46 (50.5)	45 (49.5)
Q19. Staging protests will influence the costs of Chilean university education.	32 (35.2)	59 (64.8)

Section, Statement, Item	Incorrect	Correct
Statement 3: Monarchic nations, i.e., those with royal families, differ from republic nations in several ways. An example of this difference is that citizens of monarchic nations pay more tax than citizens of republican nations.	*105 (28.8)*	*259 (71.2)*
Q20. The government of monarchic nations are responsible for setting tax rates on their citizens.	34 (37.4)	57 (62.6)
Q21. Republican nations do not have a royal family.	25 (27.5)	66 (72.5)
Q22. The only types of nation are monarchic and republican.	27 (29.7)	64 (70.3)
Q23. A monarchic nation cannot be a republican nation.	19 (20.9)	72 (79.1)
Statement 4: Charities don't have to charge VAT to customers, which means charity bookshops can charge lower prices than those charged by second-hand bookshops which are not registered as a charity.	*38 (41.8)*	*53 (58.2)*
Q24. Charities pay less tax than non-charities.	38 (41.8)	53 (58.2)
Section 3: Deductions	**122 (26.8)**	**333 (73.2)**
Statement 1: Sarah owns a new company. New companies are more likely to fail than well- established companies. Therefore:	*61 (22.3)*	*212 (77.7)*
Q25. Sarah's company will fail.	29 (31.9)	62 (68.1)
Q26. Sarah's company is more likely to fail than a well-established company.	17 (18.7)	74 (81.3)
Q27. Well-established companies are more likely to succeed than new companies.	15 (16.5)	76 (83.5)
Statement 2: May 2012 had the highest level of rainfall on record for the preceding fifty years. Predictions of rainfall are rarely accurate. Therefore:	*61 (33.5)*	*121 (66.5)*
Q28. It rained more than expected in May 2012.	48 (52.7)	43 (47.3)
Q29. The rainfall in May 2012 was greater than in May 2011.	13 (14.3)	78 (85.7)
Section 4: Inferences	**235 (51.6)**	**220 (48.4)**
Statement 1: Turkey is a surprising addition to the list of rapidly developing economies; with a GDP increase of 8.5% in the year 2011 alone. However, such rapid growth leaves worry regarding possible side-effects. For instance, in 2011 Turkey's rate of inflation was well above that of its peers. Secondly, there is increasing concern regarding Turkey's growing dependency on foreign capital. A large portion of the Turkish banking system is part-owned by banks within the Eurozone. As the single currency falters, such a dependency raises questions about the stability of Turkish growth.	*235 (51.6)*	*220 (48.4)*
Q30. There are concerns that Turkey's development is at risk of faltering in the years after 2011.	37 (40.7)	54 (59.3)
Q31. As Turkish banks are part-owned by those in the Eurozone, they may suffer if the European banks face financial difficulty.	73 (80.2)	18 (19.8)
Q32. The Turkish banks are part-owned by European banks as this provides greater variation to the market and extra finance to the economy.	44 (48.4)	47 (51.6)
Q33. Turkish banks are part-owned by European banks as this provides greater economic links with the Eurozone, helping their ascension into the European Union.	41 (45.1)	50 (54.9)
Q34. The Turkish economy was surprisingly stagnant in 2011.	40 (44.0)	51 (56.0)

Section, Statement, Item	Incorrect	Correct
Section 5: Interpreting Information	**155 (28.4)**	**391 (71.6)**
Statement 1: The British National Library has the largest collection of publicly-owned books in the United Kingdom. Therefore:	*63 (23.1)*	*210 (76.9)*
Q35. There might be a larger collection of books in the United Kingdom.	22 (24.2)	69 (75.8)
Q36. There might be a larger collection of publicly-owned books in the United Kingdom.	28 (30.8)	63 (69.2)
Q37. The British National Library is in the United Kingdom.	13 (14.3)	78 (85.7)
Statement 2: People with a master's degree in business administration (MBA) earn an income on average 70% higher than people with just an undergraduate degree. MBA students from top business schools earn an income on average 50% higher than the average income of people with MBAs.	*92 (33.7)*	*181 (66.3)*
Q38. If a person obtains an MBA, their income will increase.	32 (35.2)	59 (64.8)
Q39. If a person obtains an MBA from a top business school, their income will be higher than that of the average MBA graduate.	41 (45.1)	50 (54.9)
Q40. The average income of an MBA graduate from a top business school is over double that of the average income of a person holding only an undergraduate degree.	19 (20.9)	72 (79.1)

From the results shown in

Figure 7: Students' Incorrect vs. Correct Answers for all Categories

Table , and as shown in

Figure , 'Arguments' aspect is the top category of the highest aptitude for critical thinking by students, as they provided 76.3% of answers correctly. Under Argument, they have highly answered Statement 1 correctly by 81.0%, followed by 76.9% for Statement 2, 75.3% for "Statement 4, and finally 72.8% for Statement 3. For 'Assumptions' aspect, students provided 71.2% of answers correctly for Statement 3, followed by 68.5% for Statement 1, 60.4% for Statement 2, and finally, 58.2% for Statement 4. In 'Deductions' section, students could answer 77.7% of Statement 1correctly, while they did 66.5% for Statement 2. While, for the five questions in the 'Inferences' statement, students provided correct answers by percentages that ranged between 19.8% and 59.3%. Therefore, it can be said that students did not have high aptitude for correct answers in Inferences. Lastly, in the 'Interpreting Information' aspect, students provided 76.9% of correct answer for Statement 1, while 66.3% for Statement 2.

4.2 Students' Performance

Students' responses in all sections and as an overall test were converted into percentiles for better comparisons, using the formula below. Percentile scores then were converted into bins to reflect the norm group of Overall Performance on the W-GCTA as A, B, C, D, or E. In

Table , a descriptive summary of the five sections and overall score in terms of students' Overall Performance.

$$Percentile = \frac{Number\ of\ Correct\ Values\ for\ a\ Student\ \times 100}{Total\ Number\ of\ Values}$$

As shown in the table, as overall percentile score, 57.1% of students got a "C", 26.4% got an "A", and 16.5% got a "B". In terms of sections, on the top is Deductions, as 41.8% of student got an

"A", compared to other sections. For students who got a "B", the largest proportion 19.8% was in Inferences. For "C", and the largest proportion 50.5% was in Assumptions. In Inferences, 20.9% of students got a "D", which is the highest compared to other sections, and also 15.4% got an "E" in Inferences, indicating low aptitude for correct answers.

Table 8. Frequencies and Percentages of Percentile Scores as Norm Groups

Section	A	B	C	D	E
Arguments	37 (40.7)	9 (9.9)	44 (48.4)	1 (1.1)	-
Assumptions	32 (35.2)	6 (6.6)	46 (50.5)	7 (7.7)	-
Deductions	38 (41.8)	12 (13.2)	32 (35.2)	8 (8.8)	1 (1.1)
Inference	12 (13.2)	18 (19.8)	28 (30.8)	19 (20.9)	14 (15.4)
Interpreting Information	33 (36.3)	11 (12.1)	45 (49.5)	2 (2.2)	-
Overall	24 (26.4)	15 (16.5)	52 (57.1)	-	-

4.3 Norms & Scoring Analysis

A one-sample t test was conducted to find whether or not high school students' score percentiles are equal to the Overall Performance on the W-GCTA of 67 or not. The results are presented in

Table , showing that there was a significant mean difference in Arguments, Deductions, and Inferences, where p-value < 0.05. There was no significant mean difference in the overall performance, p-value = 0.507, indicating that the overall students' performance is not statistically different from the Overall Performance on the W-GCTA of 67. On the other hand, students had mean Arguments percentile score of 76.28, which is statistically higher than the Overall Performance on the W-GCTA of 67, p-value < 0.001, and also had mean Deductions percentile score of 73.19, which is statistically higher than the Overall Performance on the W-GCTA of 67, p-value = 0.037. On the contrary, they had a mean Inferences percentile score of 48.35, which is statistically lower than the Overall Performance on the W-GCTA of 67, p-value < 0.001. Students

performed averagely in Assumptions and Interpreting Information; i.e., the mean percentile scores did not differ from the Overall Performance on the W-GCTA of 67, p-value = 0.693 and 0.093, respectively.

Table *9*. One-sample t Tests - test value = 67

	Statistics		One-sample Test		
Section	**Mean**	**SD**	**t**	**Sig.**	**Mean Difference**
Arguments	76.28	21.585	4.102	<.001**	9.28
Assumptions	65.84	27.918	-.396	.693	-1.16
Deductions	73.19	27.844	2.120	.037*	6.19
Inferences	48.35	33.475	-5.314	<.001**	-18.65
Interpreting Information	71.61	25.879	1.700	.093	4.61
Overall Performance	68.57	22.507	.666	.507	1.57

**. Significant at .05. **. Significant at .01.*

4.4 Section Differences

A one-way repeated-measures ANOVA with "section" as the within-subject factor yielded a significant main effect of "section" on the percentiles ($F(3.431,308.758) = 38.118$, $p < 0.001$, $\eta^2 = 0.298$); with a Greenhouse-Geisser correction as our data violated the assumption of sphericity (Mauchly's W = 0.744, p = 0.002). That is, the mean percentile differed statistically significantly between sections. For the section differences, Bonferroni post hoc tests showed that high school students answered significantly lower number of questions correctly in Inferences section (M = 48.35, SD = 3.509) compared to other sections. Another significant difference found was that students answered significantly lower number of questions correctly in Assumptions section (M = 65.84, SD = 2.927) compared to their answers in Arguments (M = 76.28, SD = 2.263) and Deductions (M = 73.19, SD = 2.919). No other statistically significant differences were found.

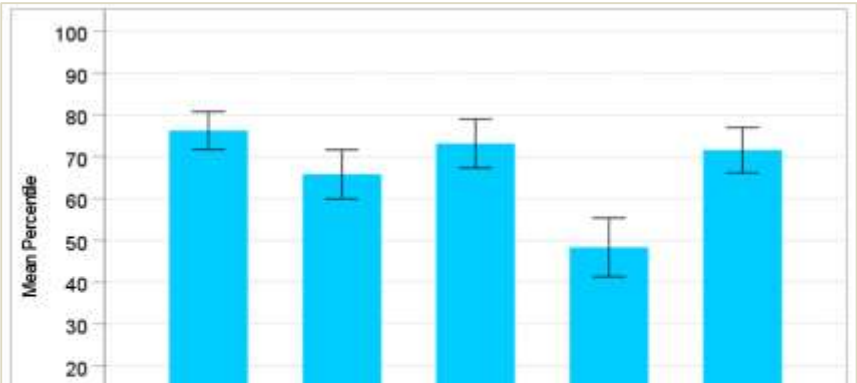


Figure 8. Bar Chart of Estimated Marginal Means of Percentiles for the five Sections for all Students, with ±2 Standard Error

4.5 Demographic Differences

Independent-sample t tests were performed to determine whether or not there is significant differences between girls and boys in terms of their overall performance percentiles and section percentile scores. The test results, presented in Table , showed that there were no statistically significant differences between girls and boys in any percentile score, p-value > 0.05, and any differences between boys and girls were random and only due to chance.

Table 10. Independent-Samples t Test Results, Grouping Variable: Gender

	Girls		**Boys**		**t-test**		
	M	**SD**	**M**	**SD**	**t**	**df**	**Sig.**
Overall Performance	67.24	19.680	70.12	25.572	-.593	76.380	.555
Arguments	75.68	19.308	76.98	24.195	-.281	78.099	.780
Assumptions	63.44	26.940	68.65	29.090	-.887	89	.377
Deductions	72.65	26.675	73.81	29.463	-.196	89	.845
Inferences	46.53	28.103	50.48	39.072	-.545	73.140	.588
Interpreting Information	70.75	22.956	72.62	29.176	-.336	77.433	.738

4.6 Summary

To recall, the purpose of this research is to examine the level of critical thinking aptitudes of high school students in a private school in Dubai. To fulfil this purpose, students' general level of critical thinking as well as their level of skill in specific areas were examined. Students' responses were statistically analyzed and the results of this analysis indicated a general high aptitude of students' critical thinking. However, in terms of the five areas investigated in the present study,

students had different aptitudes. The analysis showed that the high aptitude was in Arguments, while the lowest aptitude was in Inferences. In Assumptions, Deductions, and Interpreting Information, students had similar high critical thinking aptitudes. The analysis also showed no gender differences in any of these areas, or generally. Therefore, to answer the first research question, it can be concluded that high school students in a private school in Dubai have as measured by the W-GCTA test had overall high critical thinking aptitude. The second research question was answered by the fact that there were no gender differences in students' level of critical thinking aptitudes as measured by the W-GCTA test.

CHAPTER 5

DISCUSSION, IMPLICATIONS, RECOMMENDATIONS, CONCLUSION & LIMITATIONS

5.1 Discussion

When examining the study's findings, participants demonstrated a very good critical thinking skills profile. The findings revealed an average score of 76 %, which is above the average score based on group norms, with four sections to be the most significant in the W-GCTA test results, which are: assumptions, arguments, deductions and interpreting information and drawing conclusions, with arguments' section hitting the highest score. In response to the research question 1, grade 10 and 11 students have demonstrated the ability to think critically. This gives an indication that the students have been trained and exposed to different academic experiences that helped foster their critical thinking skills. The study findings contradicted those of similar previous research in literature, in which critical thinking skills were assessed via W-GCTA in the aspects of data reduction, data display, and conclusion drawing, and where the findings revealed that: (a) high school students' critical thinking skills were in the poor category; and (2) deduction, information, and inference are the least mastered critical thinking sub-skills by students when compared to other critical thinking sub-skills (Didi and Sri 2021).

For research question 2, the results showed that the boys scored more than the girls in all the aspects of the W-GCTA test, however the difference between both gender scores is statistically insignificant, concluding that students' critical thinking aptitude appears to be unaffected by demographic differences. This finding is similar to research discussed earlier in the literature. Changes in the interpretation of information, infereing, deducing assumptions, and conclusion elements of critical thinking are unaffected by gender (Youssef 2021).

In the 'Arguments' section, students were able to identify the difference between a strong and a poor argument while making critical judgments. They could distinguish between a compelling argument that is both necessary and relevant to the question, and a weak argument that is unrelated to the subject, and is minor in relevance, or is related to a minor component of the question, or mistakes correlation with causation. Students' ability to analyze information objectively and properly, and to favor information that supports an existing point of view and not allowing emotions to get in the way of objective assessment (Pearson 2017; Wulandari & Hindrayani 2021), is very essential to the process of critical thinking, in relation with the RED model discussed in the literature.

The 'Deductions' section of the test reflects almost the same analysis as the 'Interpreting Information' section. With an average score of 70.5% of both sections, it is evident that students possess the elements of thoughts as discussed in the Paulian theory. Students were able to determine if the notion offered in the statement was supported by the facts presented, or whether the deduction had nothing to do with the hypothesis and there wasn't enough data to back it up. In addition, they were able to apply their knowledge of an idea in a variety of ways. apply data, and generate new information (Rahman & Manaf 2017). This is a set of abilities that span Bloom's taxonomy levels (Zaidi et al. 2017) and can be learnt and taught (Arievitch, 2020).

Scores of the section of 'Assumptions' are lower in contrast with the other sections discussed, with an average percentage of 63.4% for girls and 68.7 % for boys. In this section of the W-GCTA test, students begin with a hypothesis or assumption that they believe is correct, then look for evidence to support or refute it. As a result, a premise that is regarded to be valid or true is developed (Danczak 2018). This is a crucial aspect of critical thinking.

The section with the lowest score among all the sections of the W-GCTA test, is 'Inferences' according to the exam results. In this section students were asked to draw a conclusion from facts that have been observed or assumed in the provided statement. of possible inferences based on the information in the statement. This aspect of critical thinking is considered a creative skill as reviewed in the literature of the guided inquiry teaching technique. On the other hand, students' critical thinking skills were scored at low percent in the 'Inferences' component, in contrast with the other components of the W-GCTA test.

In classroom activities, peer interaction is acknowledged as an important element that aids in the development of critical thinking. Guided inquiry instruction is thought to encourage this type of group engagement. Because most humans lack educated rational reasoning, thinking is a spontaneous mental activity that must be regulated to avoid misleading conclusions and must have a bias (Forawi 2016). As a result, approaches to aid in the development of critical thinking abilities among students are required. Active learning is one of the effective strategies. Students can participate in inquiry-based learning experiences with this pedagogical approach. In the relevant literature, inquiry-based teaching approaches have been repeatedly cited as an effective way to encourage critical thinking in the classroom (Forawi 2016).

According to Paul and Elder (2019), critical thinking is a structured cognitive process that requires active and skilled participation in problem-solving, concept development, application, reasoning, analysis, synthesis, observation, data collection, meditation, and interaction. The majority of the critical thinking definitions reviewed in this study share a common feature that indicates higher-order cognitive processes involved in critical thinking. As a result, critical thinking is a complicated mental process that heavily relies on logic, and it should not be seen exclusively as such.

In conclusion, critical thinking abilities are likely to be present in the process, societal-oriented practices where learning is open-ended (Forawi & Mitchell 2016). Students can improve their metacognitive awareness by reflecting on and discussing their own mental processes. (Perez 2019). This perspective is also reinforced in the new NGSS (2013) document, which recognizes that curriculum standards for critical thinking alone do not serve as a practical framework, therefore effective new instructional strategies are required to attain the intended goals. The collaborative

learning and guided inquiry learning approaches have been recommended for effective teaching to improve students' literacy and learning, as found in the study to exhibit critical thinking (Putra et al. 2018).

5.2 Conclusion

Students' learning experiences have a significant impact on their critical thinking abilities. If students are routinely given training to conduct CT exercises within the learning process, they will develop critical thinking skills. As a result, future research should stress the importance of instilling critical thinking skills in kids at a young age and making it a top educational goal. Furthermore, teachers should establish teaching approaches that allow students to participate in activities that test critical thinking skills growth (Chu et al., 2017 and Emerson, 2019). Teachers are viewed as "the authority" in defining assessment criteria and methods in the classroom. As a result, the long-standing tradition of adopting teacher-centered practices in the classroom may be prompting students to choose a performance-goal orientation, limiting CTS acquisition and development.

Additionally, it is the institutes' responsibility to keep a closer check on real classroom instruction. Schools constantly provide messages to students about what rules to obey, what roles to play, what assumptions to make, what to believe, and what to think, as mentioned by Harro (Perez 2019). Institutions, according to Harro, develop norms, positions, and assumptions that are part of a framework that is enforced by providing advantages or punishment to its members. The adoption of teacher-centered methods in classrooms, fueled by a traditional educational system, is leading students to believe that they are academically engaged only for the purpose of completing academic endeavors, which, in most cases, do not involve any academic challenge. In conclusion, Critical thinking skills of students must be assessed once educated (Abazar, 2020). Several tools are available to assist with this, but evaluators must ensure that they are utilized correctly and in the suitable setting, as changes in testing methodologies can affect the results' accountability (Forwai, 2020). Research of how teachers integrate reasoning and critical thinking abilities into teaching and boosting students' learning should also be carried out. According to the ‘Theory of Formal Discipline’, which claims that teaching students’ arithmetic for everyday life improves their universal critical thinking skills (Perez 2019).

Eventually, we can state unequivocally that critical thinking in education is the magic wand that will usher in a knowledge-actions-based society. Whether in the UAE or elsewhere in the world, that knowledge-actions-based society would be able to maintain control over the present while deciding on and planning for the future while complying to high moral and ethical standards.

5.3 Implications & Recommendations

Students with the ability to think critically, demand an academic atmosphere that encourages intellectual challenge and debate. To improve the quality of effort students put to advance academically in their study, instructors should empower students in a demanding educational environment, employing classwork and homework as vital ways to support both academic success and CTS development.

K-12 educational institutions should invest all necessary resources, demonstrate operational flexibility, and foster a supportive institutional culture. While there is consensus on the importance of student expectations on academic success, educational institutions must do more to keep students engaged in their studies. They should use student-centered teaching strategies in the classroom to improve the academic experience of students. The adoption of student-centered techniques appears to be required at the institutional level; as a result, institutions should hire skilled teachers capable of implementing student-centered methods in classrooms to meet academic needs. The findings of the current study, would allow academics to improve curricular programs and could help guide future efforts to increase critical thinking skills in many disciplines, not only in the UAE, but in a variety of settings.

Moreover, a reform in instructional approaches is required to increase student critical thinking. Instructors must incorporate more favorable methods that promote and enhance students' critical thinking skills, learning and mastery. Collaborative, cooperative, active, independent, guided inquiry teaching techniques and problem-inquiry learning methods are among them. In learning activities, memorization should not be prioritized (DuDevoir 2018). Students should be able to generate, understand, and evaluate information in order to solve issues and make decisions. While solving problems, teamwork and communication are also stressed during the learning process (Hagemann & Kluge 2017). Also, for students to build greater critical thinking skills, technology

such as simulations, animations, and gaming should be used. Additionally, improving instructor-student contact promotes students' commitment in learning, which improves critical thinking skills. Qualitative study should be undertaken to determine which effective methods must be followed in order to transition from teacher-centered to student-centered teaching. Also, research into the levels of academic difficulty required in UAE classrooms to support the development of critical thinking abilities across the different field is necessary. Besides, critical thinking interventions are not encouraged enough in Arab educational institutions and universities. By the time they graduate, all students are supposed to have mastered critical thinking; yet, this is not the case. One way is to expose students to at least one or more specialist courses that focus on critical thinking basic abilities. Not to mention critical thinking assessment which should be prioritized in Arab k-12 educational institutions and universities. Only a few institutions in the region analyze critical thinking on a regular basis, and the great majority do not. This hinders institutions from reaching their full potential. Critical thinking evaluations should be required of students by teachers and schools' administrators. Critical thinking baseline evaluations assist instructors in better planning for critical thinking improvement. Lastly, it is necessary to invest more in the development of Arab critical thinking assessments. Most scholars and educational institutions rely on Western tools, which are full of references that Arab students are unfamiliar with. Educational institutions, research institutes, and future researchers are expected to create, validate, and apply unique evaluations on their campuses. This allows for a more accurate evaluation of critical thinking without relying on methods designed for foreign populations. To study the disparities in critical thinking skills across Arab students, large-scale and longitudinal studies should be conducted. Future study should focus on large representative samples that are randomly designed. Similarly, another important field of research should be tracking critical thinking changes through time and understanding the reasons that cause such changes.

5.4 Limitations

Perhaps the most significant limitation of the current study is the extent to which the findings may be applied to a wide range of general education students. The purpose of this study was examining the critical thinking aptitude of grades 10 and 11 students in a private school in Dubai,

and checking if there were any demographic differences in the results of the W-GCTA test. Data was gathered in order to answer two study questions on this purpose. The analysis of data yielded several notable findings. Although important, the findings have several limitations. First and foremost, it is a transversal design that does not allow causal links between variables to be established. It is recommended that longitudinal or experimental designs be used to investigate the causal links between the variables. For example, it would be better to conduct a quasi-experiment including an intervention, with pre- and post-test to assess the critical thinking skills of students. This design would help to link the impact of students' academic experiences on CTS development.

In addition, individual interviews could be done with high-performing students after performing the test, to reveal more about the specific tactics used by them to adjust for thinking constraints in daily life. Also, it would have been particularly interesting to learn how the high- and low-performing poor critical thinkers evaluated their potential to do well in the test and what it would take for them to do well in tests similar to the one featured in this study. On the basis of precision, some of the data acquired for the study could be questioned, since confounding variables should have been considered (Jeske & Yao, 2020). Because different instructors monitor students while performing the test, the exam circumstances were not identical. The responses of the students could have been influenced by this instructor. Lastly, because this sample is from a specific region, it does not represent the diversity of Emirati students. The study's external validity is limited by the difficulties in recruiting a large representative random sample. While the study's sample is diverse, reflecting many various segments of the community, it was not chosen at random or in a large sample size. Although the use of 91 students in a quantitative design appears to be sufficient, the wide range of students in UAE necessitates a larger sample from each category in the population from different schools in Dubai, and the other emirates.

References

Abdulah, M. & Wangid, N. (2021). The development of self-perception instrument of students' critical thinking skills. *Journal of Physics*.

Ab Kadir, M. (2017). What teacher knowledge matters in effectively developing critical thinkers in the 21st century curriculum? *Thinking Skills and Creativity*, Vol. 23, pp. 79–90

Ahmad, S., Wasim, S., Irfan, S., Gogoi, S., Srivastava, A. & Farheen, Z. (2019). Qualitative v/s quantitative research. Vol 6. pp. 2828-2832.

Al-Zou'bi, R. (2021). The impact of media and information literacy on acquiring the critical thinking skill by the educational faculty's students. *Thinking Skills and Creativity*.

Amena, M. (2020). Fostering critical thinking skills in EAP learners.

Amin, A. & Adiansyah, R. (2018). Lecturers' perception on students' critical thinking skills development and problems faced by students in developing their critical thinking skills. *Jurnal Pendidikan Biologi Indonesia*.

Andersson, E. & Malmberg, B. (2018). Segregation and the effects of adolescent residential context on poverty risks and early income career: a study of the Swedish 1980 cohort. *Urban Studies*, Vol. 55: pp.365–383

Arievitch, I. (2020). Reprint of: the vision of developmental teaching and learning and Bloom's taxonomy of educational objectives. *Learning, culture and social interaction*, Vol. 27, pp. 100473.

Assche, K., Valentinov, V. & Verschraegen, G. (2019). Ludwig von Bertalanffy and his enduring relevance: Celebrating 50 years General System Theory. *Systems Research and Behavioral Science*

Bagheri, F. & Ghanizadah, A. (2016). Critical thinking and gender differences in academic self-regulation in higher education. *Journal of Applied Linguistics and Language Research*, Vol. 3 (3), pp. 133-145.

Ballakrishnan, K., & Mohamad, M. (2020). Teachers' teaching methods in teaching higher order thinking skill (Hots) comprehension questions. *International Journal of Academic Research in Business and Social Sciences*, Vol. 10 (2), pp. 362–378

Baker, F. & Kim, S. (2017). *The basics of Item Response Theory using R*. New York, NY: Springer.

Bhandari, P. (2020). *What is quantitative research? Definition, uses and methods*.

Billings, M., DeRuchie, K., Haist & S. (2016). *Constructing written test questions for the basic and clinical sciences*. Philadelphia, PA: National Board of Medical Examiners.

Bissonnette, M., Chastenay, P. & Francoeur, C. (2021). Exploring adolescents' critical thinking aptitudes when reading about science in the news. *Journal of Media Literacy Education*, Vol. 13 (1), pp.1-13

Blazar, D. & Kraft, M. (2017). Teacher and teaching effects on students' attitudes and behaviors. *Educational Evaluation and Policy Analysis*, Vol. 39 (1), pp. 146–170.

Bloomfield, J. & Fisher, M. (2019). Quantitative research design. *Journal of the Australasian Rehabilitation Nurses Association.*

Blything, L., Hardie, A. & Cain, K. (2020). Question asking during reading comprehension instruction: a corpus study of how question type influences the linguistic complexity of primary school students' Responses. *Reading Research Quarterly*, Vol. 55, pp. 443– 472

Bouilheres, F., Le, L., McDonald, S.,Nkhoma, C. & Jandug-Montera, L. (2020). Defining student learning experience through blended learning. *Education and Information Technologies* Vol. 25, pp. 3049–3069

Brentnall, J., Thackray, D. & Judd, B. (2022). Evaluating the clinical reasoning of student health

professionals in placement and simulation settings: a systematic review. *International Journal of Environmental Research and Public Health*, Vol. 19

Budsankom, P., Sawangboon, T., Damrongpanit, S. & Chuensirimongkol, J. (2015). Factors affecting higher order thinking skills of students: a meta-analytic structural equation modeling study. *Educational Research and Reviews*, Vol. 10 (19), pp. 2639-2652

Cáceres, M., Nussbaum, M. & Ortiz, J. (2020). Integrating critical thinking into the classroom: a teacher's perspective. *Thinking Skills and Creativity*, Vol. 37, p.100674

Carter, A., Creedy, D., & Sidebotham, M. (2015). Evaluation of tools used to measure critical thinking development in nursing and midwifery undergraduate students: a systematic review. *Nurse Education Today*, Vol. 35 (7), pp. 864-874.

Casteel, A. & Bridier, N. 2021. Describing populations and samples in doctoral student research. *International Journal of Doctoral Studies*, Vol. 16

Chu, S., Reynold, R., Tavares, N. & Notari, M. (2017). *21st century skills development through inquiry-based learning; from theory to practice*. Springer

Collaço, C.(2017). Increasing student engagement in higher education. *Journal of Higher Education Theory and Practice*, Vol. 17 (4), pp. 40–47.

Cone, C., Godwin, D. & Salazar, K. (2016). Incorporation of an explicit critical-thinking curriculum to improve pharmacy students' critical-thinking skills. *Am J Pharm Educ*, Vol. 80 (3), pp. 1–5.

Council of Europe. (2016). Competences for democratic culture. Living together as equals in culturally diverse democratic societies. CoE: Strasbourg, France.

Council of European Union. (2015) Declaration on Promoting Citizenship and the Common Values of Freedom, Tolerance and Non-Discrimination through Education; Eurydice: Brussels, Belgium. [online] Available at: https://ec.europa.eu/assets/eac/education/news/2015/documents/citizenship-education-declaration_en.pdf
Croskerry, P., Cosby, K., Graber, M. & Singh, H. (2017). Diagnosis: interperting the shadows.

Cummings, C., Mason, D., Shelton, K., & Baur, K. (2017). Active learning strategies for online and blended learning environments. *Breakthroughs in Research and Practice*, pp. 88–114

Cuyjet, M., Linder, C., Howard-Hamilton, M., & Cooper, M. (2016). *Multiculturalism on campus*. 2 edn. Sterling, VA: Stylus Publishing, LLC.

Daly, P. (2018). A concise guide to clinical reasoning. *Journal of Evaluation in Clinical Practice*, Vol. 24 (5), pp. 966-972

Danczak, S. (2018). *Development and validation of an instrument to measure undergraduate chemistry students' critical thinking skills*. PhD. Thesis. Monash University.

Daniel, L., Meng, K., & Loh, S. (2020). Relationship of creativity and critical thinking to pattern recognition among Singapore private school students. *Journal of Educational Research*

David, H. (2020). *Critical Thinking*, *The Stanford Encyclopedia of Philosophy*.

Deng, S., & Bolt, D. (2016). A sequential IRT model for multiple-choice items and a multidimensional extension. *Applied Psychological Measurement*. Vol. 40, pp. 243–257.

Dewey, J. (1933). How we think: a restatement of the relation of reflective thinking to the educative process, Heath & Co Publishers: Boston, MA, USA.

de Zeeuw, G. (2021). Strategies beyond systems. in: D. Baecker (eds). *Schlüsselwerke der Systemtheorie.* Springer VS, Wiesbaden. https://doi.org/10.1007/978-3-658-33415-4_6

Didi, S. & Sri, F. (2021). Investigation of Watson-Glaser critical thinking skills of junior high school students in solving mathematical problems. *Journal of Physics*.

DuDevoir, C. (2018). It's not a memory test; education needs to focus on critical thinking.

Elder, L. & Paul, R. (2020). Critical thinking: tools for taking charge of your learning and your life. *Foundation for Critical Thinking*
Elder, L. & Paul, R. (2020). Critical thinking: tools for taking charge of your professional and personal life.

Emerson, K. (2019). A model for teaching critical thinking. [Online]. Available at: http://files.eric.ed.gov/fulltext/ED540588.pdf

Ennis, R. (2015). *Critical thinking: a streamlined conception*.

Esenturk, B. & Asi, D. (2022) Teachers predicting self-regulation skills of children: the relationships among teacher beliefs, teaching intentions and preschoolers' self-regulation skills. *Education*, Vol. 3pages 1-13.

Etikan, I. & Bala, K. (2017). Sampling and sampling methods. *Biometrics & Biostatistics International Journal*, Vol. 5 (6), pp. 215-217.

Eun, C. & Lee Mi-Suk, L. (2018). Determinants of latent profiles in higher-order thinking skills of Korean university students. *Problems of Education in the 21st Century*

Evans, C. (2020). Measuring student success skills: a review of the literature on critical thinking.

Evi, R., Ari, W., Widi, P. & Riandi, R. (2019). Development of argumentation-based critical thinking skills tests in Microbiology laboratory. *Scientiae Educatia*

Facione, A. (2015). *Critical thinking: what it is and why it counts. insight assessment.*

Fielding, N., Lee, R. & Blank, G. (2017). *The SAGE Handbook of online research methods*. SAGE Publications Ltd.

Forawi, S. (2016). Standard-based science education and critical thinking. *Thinking Skills and Creativity*, Vol. 20, pp. 52-62.

Forawi, S. (2020). *Science and mathematics education in multicultural contexts: new directions in teaching and learning*. Champaign, IL: Common Ground Research Networks.

Fuad, N., Zubaidah, S., Mahanal, S. & Suarsini, E. (2017). Improving junior high Schools' critical thinking skills based on testing three different models of learning. *International Journal of Instruction*, Vol. (10), pp. 101-116.

Gbollie, C. & Keamu, H. (2017). Student academic performance: the role of motivation, strategies, and perceived factors hindering Liberian junior and senior high school students' learning. *Education Research International*.

Gelerstein, D., Del Rio, R., Nussbaum, M., Chiuminatto, P. & López, X. (2016). Designing and implementing a test for measuring critical thinking in primary school. *Thinking Skills and Creativity*, Vol. 20, pp. 40–49

Haber, J. (2020). *It's time to get serious about teaching critical thinking.* The MIT Press Essential Knowledge series

Halpern, D. (2016). *Halpern Critical Thinking Assessment*. [online]. Available at https://drive.google.com/file/d/0BzUoP_pmwy1gdEpCR05PeW9qUzA/view

Hanson, J. & Florestano, M. (2020), Classroom assessment techniques: a critical component for effective instruction. *New Directions for Teaching and Learning*, pp. 49-56

Hasan, M. & Pri, S. (2020). Implementation of guided inquiry learning oriented to green chemistry to enhance students' higher-order thinking skills. *Journal of Physics* [online]. Available at: https://www.researchgate.net/publication/339680788_Implementation_of_guided_inquiry_learning_oriented_to_green_chemistry_to_enhance_students'_higher-order_thinking_skills

Hidayati, Y. & Sinaga, P. (2019). The profile of critical thinking skills students on science learning. *Journal of Physics.*

Hitchcock, D. (2017). Critical thinking as an educational ideal, in his nn reasoning and argument: essays in informal logic and on critical thinking. *Dordrecht: Springer*, pp. 477–497.

Hitchcock, D. (2018). *Critically Thinking*. *The Stanford Encyclopedia of Philosophy* [online]. Available at: https://plato.stanford.edu/archives/fall2018/entries/critical-thinking/

Holland, B. (2018). *Critically Thinking. About Critical Thinking* [Online]. Available at: https://www.edweek.org/leadership/opinion-critically-thinking-about-critical-thinking/2018/06

Hollis, H., Marina, R. & Leslie, v. & Elder, L. (2020). Validity and reliability testing of the International Critical Thinking Essay Test form A (ICTET-A).

Huber, C. & Kuncel, N. (2016). Does college teach critical thinking? A meta-analysis. *Review of Educational Research*, Vol. 86 (2), pp. 431-468

Jeske, D. & Yao, W. (2020). Sample size calculations for mixture alternatives in a control group vs. treatment group design. *Statistics: A Journal of Theoretical and Applied Statistics* [online]. Vol. 54. pp. 1-17. Available at: http://dx.doi.org/10.1080/02331888.2020.1715407

Johnson, R. (2014). *Educational research, quantitative, qualitative, and mixed approaches*.

Idi, W., Ruly, M., Muhamad, U., Muslim, A. (2021). The impact of collaborative learning on learners' critical thinking skills. *International Journal of Instruction*, Vol. 14 (2). p443-460

Insight Assessment. (2017). California critical thinking disposition inventory (CCTDI). [online]. Available at:
https://www.insightassessment.com/Products/Products-Summary/Critical-Thinking-Attributes Tests/California-Critical-Thinking-Disposition-Inventory-CCTDI

Item Response Theory (2022). Population Health Methods [online]. Available at: https://www.publichealth.columbia.edu/research/population-health-methods/item-response-theoryAppendices
Appendix 1: W-GCTA

Kena, G., Jhonson, F., Wang, X., Zhang, J., Rathbun, A., Wilkinson, L. & Kristapovich, P. (2014). The condition of education.

Klyukovski, A. & Medlock-Klyukovski, A. (2016). Instructor strategic ambiguity: delineation of the construct and development of a measure. *Communication Education*, Vol. 65 (3), pp. 253-271.

Ku, K., Lee, V. & Ellis, J. (2017). Using artwork as problem context in generic critical thinking instruction: A strategy for thoughts. *Thinking Skills and Creativity*, Vol. 25, pp. 53-59

Kubberød, E. & Pettersen, I. (2017). Exploring situated ambiguity in students' entrepreneurial learning. *Education & Training*

Kwantlen, M. (2019). *Cooperative learning group activities for college courses*. Ph.D. Thesis University College

Lamb, S., Maire, Q. & Doecke, E. (2017). Key Skills for the 21st Century: An Evidence-Based Review. [online]. Available at: http://vuir.vu.edu.au/35865/1/Key-Skills-for-the-21st-Century-Analytical-Report.pdf

Lee, J., Lee, Y., Gong, S., Bae, J. & Choi, M. (2016). A meta-analysis of the effects of non-traditional
teaching methods on the critical thinking abilities of nursing students. *BMC Medical Education*, Vol. 16

Lee, J., Lee, Y., Bae, J., & Seo, M. (2016). Registered nurses' clinical reasoning skills and reasoning process: a think-aloud study. *Nurse Education Today*, Vol. 46, pp. 75–80.

Lee, Y. (2018). Nurturing critical thinking for implementation beyond the classroom: Implications from social psychological theories of behavior change. *Thinking Skills and Creativity*, Vol. 27, pp. 139–146.

Li, Z., Cai, X., Kuznetsova, M. & Kurilova, A. (2022) Assessment of scientific thinking and creativity in an electronic educational environment. *International Journal of Science Education*, pp. 1-24.

Lindsay, E. (2015). Graduate outlook 2014 employers' perspectives on graduate recruitment in Australia. Melbourne: graduate careers Australia.

Lombardi, L., Mednick, F., Backer, F. & Lombaerts, K. (2021). Fostering critical thinking across the primary school's curriculum in the European schools system. *Education Sciences*.

Mahmoud, A. & Mohamed, H. (2017). Critical Thinking Disposition among Nurses Working in Puplic Hospitals at Port-Said Governorate. *International Journal of Nursing Sciences*, Vol. 4 (2), pp. 128-134.

Maciejewski, M. (2020). Quasi-experimental design. *Biostatistics & Epidemiology* [online]. Vol. 4 (1), pp. 38-47. Available at: https://doi.org/10.1080/24709360.2018.1477468

Marni, S., Aliman, M., Suyono, S. & Roekhan, R. (2020). Students' critical thinking skills based on gender and knowledge group. *Journal of Turkish Science Education*. Vol. 17, pp. 544-560.

McLaren, P. (2015). Life in schools: An Introduction to critical pedagogy in the foundations of education; Routledge: London, UK.

McPeck, J. (2016). *Critical thinking and education*. Routledge: London, UK.

Mertler, C. (2021). *Introduction to educational research*. SAGE Publications, Inc.

Ministry of Cabinet Affairs. (2022). *National Agenda* [online]. Available at: *https://u.ae/en/about-the-uae/strategies-initiatives-and-awards/federal-governments-strategies-and-plans/national-agenda*

Miterianifa, M. & Ashadi, A. & Saputro, S. (2021). A Conceptual framework for empowering students' critical thinking through problem based learning in chemistry. *Journal of Physics* [Online]. Available at: 012046. 10.1088/1742-6596/1842/1/012046.

Mohammadi, S. & Talebinejad, M. (2015). Language learning context, learning style and Iranian EFL students' essay writing performance: a critical thinking perspective in a Web. 2.0 environment. *Theory and Practice in Language Studies*, Vol. 5 (7), pp.1412-1422.

Mozafari, Z., Abdollahi, M., Farzad, V. & Ghayedi, Y. (2021). The effectiveness of Paul-Elder model critical thinking training on students' critical thinking skill. *Journal of Educational Psychology Studies*, Vol. 18 (44), pp. 36-25

Nicholas, M. & Raider-Roth, M. (2016). A Hopeful Pedagogy to Critical Thinking. *International Journal for the Scholarship of Teaching and Learning*.

Nisa, E., T Koestiari, T., Habibbulloh, M. & Jatmiko, B. (2017). Effectiveness of guided inquiry learning
model to improve students' critical thinking skills at senior high school. *Journal of Physics*.

Nohria, N. (2021). What the Case Study Method Really Teaches. *Business Education*

Nornoo, A., Jackson, J. & Axtell, S. (2017). Investigating the correlation between pharmacy student performance on the health science reasoning test and a critical thinking assignment. *American Journal of Pharmaceutical Education*, Vol. 80(3), pp. 1–5.
O'Hare, L. & McGuinness, C. (2015). The validity of critical thinking tests for predicting degree performance: a longitudinal study. *International Journal of Educational Research*, Vol. 72, pp. 162-172

Okechukwu, U. (2021). Determinants of critical thinking of trainee teachers: a production function approach. *Thinking Skills and Creativity*

Organization for Economic Cooperation and Development (OECD). (2018). Fostering and assessing students' creative and critical thinking skills in higher education. [online]. Available at http://www.oecd.org/education/ceri/Fostering-and-assessing-students-creative-and-critical-thinking-skills-in-higher-education.pdf; accessed 2018 04 22.

Organization for Economic Co-operation and Development (OECD). (2018). The Future of education and skills: education 2030. [online] Available at: https://www.oecd.org/education/2030/E2030%20Position%20Paper%20(05.04.2018).pdf

Padmanabha, C. (2021). Critical thinking: conceptual framework. *Journal on Educational Psychology* [online], Vol. 11 (4), pp. 45-53, 2018, Available at: https://ssrn.com/abstract=3772743

Paek, I., & Cole, K. (2019). *Using R for item response theory model applications*. New York, NY: Routledge.

Paul, J. & Jefferson, F. (2019). A comparative analysis of student performance in an online vs. face-to-face Environmental Science course from 2009 to 2016. *Frontiers of Computer Science*

Paul, R. & Elder, L. (2019). *A guide for educators to critical thinking competency standards: standards, principles, performance indicators, and outcomes with a critical thinking master rubric*. Rowman & Littlefield.

Paul, R. & Elder, L. (2019). *Critical thinking model*.

Paul, R. & Elder, L. (2019). Intellectual standards. Adapted from critical thinking: concepts and tools mini-guide.

Paul, R. & Elder, L. (2019). *The miniature guide to critical thinking concepts and tools*. Rowman & Littlefield

Pearson. (2017). Better decisions. Everyday. Everywhere. Think about it! Retrieved from Pearson Talent Lens. [online]. Available at: https://downloads.pearsonassessments.com/images/assets/talent lens/
CriticalThinking-eBook.pdf

Planter, A. & Williford, L. (2017). Introduction to Student Learning Outcomes Assessment for Continuing Program Improvement: study guide. University of North Carolina at Chapel Hill.

Putra, B., Prayitno, B & Maridi, M. (2018). The effectiveness of guided inquiry and INSTAD towards students critical thinking skills on circulatory system materials. *Jurnal Pendidikan IPA Indonesia*, Vol. 7 (4), pp. 476-482.

Prokhorova, M. & Vaganova, O. (2019). Design and implementation of an educational event in the training of future managers.

Rahman, S. & Manaf, N. (2017). A critical analysis of Bloom's Taxonomy in teaching creative and critical thinking skills in Malaysia through English literature. *English Language Teaching*, Vol. 10 (9), pp. 245–256

Ramage, M. & Shipp, K. (2020). Ludwig von Bertalanffy. in: *Systems Thinkers*. Springer, London. https://doi.org/10.1007/978-1-4471-7475-2_6

Rashel, U. & Kinya, S. (2021). Development and validation of a test to measure the secondary students' critical thinking skills: a focus on environmental education in Bangladesh. *International Journal of Educational Research Review*

Rashel, U. & Shimuzu, K. (2021). Development and validation of a test to measure the secondary students' critical thinking skills: A focus on environmental education in Bangladesh. *International Journal of Educational Research Review*. Vol. 6, pp. 264–274.

Robert, N. (2022). *A critical thinking model for engineering*

Rousseau, D. (2015), General systems theory: its present and potential. *Systems Researches*, vol. 32, pp. 522– 533

Rymanowicz, K. (2016). The importance of critical thinking for young children

Ryzal, P. (2019). Analysis of student Critical and Creative Thinking (CCT) skills on Chemistry: a study of gender differences. *Journal of Educational and Social Research*, Vol. 9, p. 43

Sadaf, T. & Hassan, S. (2019). Education for sustainable development and critical thinking competency.

Saleh, S. (2019). Critical thinking as a 21st century skill: conceptions, implementation, and challenges in the EFL classroom. *European Journal* of *Foreign Language Teaching*. Vol. 4 (1), pp. 1–16.

Smalheiser, N. (2017). *Data literacy: how to make your experiments robust and reproducible*. Amsterdam: Academic Press.

Santos, F. (2017). The role of critical thinking. *Journal of Education & Practice.* [online]. Vol. 8 (20). Available at: http;//archive.org/stream/ERIC

Sarker, A. & Rahman, M. (2020). Social engineering and emiratization in the United Arab Emirates": public administration and policy. *Asia-Pacific Journal*. [online]. Vol. 23 (2), pp. 173-186. Available at: https://doi.org/10.1108/PAP-02-2020-0009

Seranica, C., Purwoko, A. & Hakim, A. (2018). Influence of guided inquiry learning model to critical thinking skills. *IOSR Journal of Research & Method in Education*, Vol. 8 (1), pp. 28-31.

Setyawan, D. & Mustadi, A. (2020). Is hidrorium able to improve the students' critical thinking skills?. *Jurnal Prima Edukasia*. Vol. 8, pp. 20-28.

Shah, T. & Rashid, S. (2018). Applying Vygotsky to adult learning.

Silvia, M., Muhammad, A., Suyono, S. & Roekhan, R. (2020). Students' critical thinking skills based on gender and knowledge group. *Journal of Turkish Science Education*, Vol. 17. pp. 544-560

Sileyew, K. (2019). *Research design and methodology*. Cyberspace, IntechOpen, London.

Starichkova, V., Moskovskaya, N. & Kalinovskaya, E. (2022). Development of students' critical thinking skills via teaching English.

Stetsenko, A. & Selau, B. (2018). Presentation–Vygotsky's approach to disability in the context of contemporary debates and challenges: charting the next steps ("special issue–Vygotsky's defectology"). *Educação*, Vol. 41 (3), pp. 315-333.

Stupple, E., Maratos, F., Elander, J., Hunt, T., Cheung, K. & Aubeeluck, A. (2017). Development of the Critical Thinking Toolkit (CriTT): A measure of student attitudes and beliefs about critical thinking. *Thinking Skills and Creativity*, Vol. 23, pp.91-100
Shubina, I. & Kulakli, A. (2019). Critical thinking, creativity and gender differences for knowledge generation in education. *Literacy Information and Computer Education Journal*, Vol. 10.

Taleb, H., & Chadwick, C. (2016). Enhancing student critical and analytical thinking skills at higher
education level in developing countries: case study of the British University in Dubai. *Journal of Educational and instructional studies in the World*.

Tebbs, T. (2017). ACCEL: thoughts from the field. *Roeper Review*, Vol. 39 (4), pp.230-233

Terada, Y. (2019). Understanding a teacher's long-term impact fostering skills like self-regulation does more to improve students' future outcomes than helping them raise their test scores.

The United Arab Emirates' Government portal. (2022). *Future Skills for Youth* **[**online]. Available at: https://u.ae/en/information-and-services/jobs/future-skills-for-youth

UNESCO-IBE. Glossary of Curriculum Terminology. (2017). UNESCO: Paris, France. [online]. Available at: http://www.ibe.unesco.org/fileadmin/user_upload/Publications/IBE_GlossaryCurriculumTerminology2013_eng.pdf

Veldhuis, M., & Van den Heuvel-Panhuizen, M. (2016). Supporting primary school teachers' classroom assessment in mathematics education: effects on students' learning.

Watson, G., & Glaser, E. (2019). *Watson-Glaser III Critical Thinking Appraisal: user's guide and technical manual*.

Watson-Glaser Critical Thinking Appraisal. (2017). [online]. Available at: https://www.pearson.com/asia

Watson-Glaser Critical Thinking Appraisal. (2018). [online]. Available at: https://www.pearson.com/asia

Watson-Glaser Critical Thinking Appraisal. Efficacy Report Summary (2020). [online]. Available at: https://www.pearson.com/asia

Watson Glaser Critical Thinking Appraisal (2022). AssessmentDay Practice Test Experts [online]. Available at: https://www.assessmentday.co.uk/

Wilson, L. (2016). Anderson and Krathwohl–Bloom's taxonomy revised. Understanding the new version of Bloom's taxonomy.

Wu, D., Xing, D. & Lu, C. (2019) The effects of learner factors on higher-order thinking in the smart classroom environment. *Journal of Computers in Education*

Wulandari, R. & Hindrayani, A. (2021). Measuring critical thinking skills with the RED Model. *In Journal of Physics*

Yezierski, K. (2018). Complexity in thinking: constructivism within Chemistry learning.
Yip, Y., Yip, K., & Tsui, W. (2021). Exploring the gender-related perceptions of male nursing students in clinical placement in the Asian context: a qualitative study. *Nursing Reports*, Vol. 11 (4), 881–890

Yousef, W. (2021). An assessment of critical thinking in the Middle East: evaluating the effectiveness of special courses interventions. *PLoS ONE*, vol. 16 (12) [Online]. Available at: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0262088

Zaidi, N., Hwang, C., Scott, S., Stallard, S., Purkiss, J. & Hortsch, M. (2017). Climbing Bloom's taxonomy pyramid: lessons from a graduate histology course. *Anatomical Sciences Education*

Zetriuslita, H., Ariawan, R., & Nufus, H. (2016). Students' critical thinking ability: description based on academic level and gender. *Journal of Education and Practice*, Vol. 7 (12), pp. 154-164

Zhao, X., Van den Heuvel-Panhuizen, M. & Veldhuis, M. (2016). Teachers' use of classroom assessment techniques in primary mathematics education: an explorative study with six Chinese teachers. International Journal of STEM Education, Vol. 3 (19).

Appendices

Appendix 1 – W-GCTA

https://www.assessmentday.co.uk/watson-glaser-critical-thinking.htm

Appendix 2 – Guardian Consent Form

Consent Form

Dear parent(s),

I am a postgraduate student undertaking a master degree at The British University in Dubai and I am conducting research for my master dissertation. Here is a brief introduction to my dissertation:

Educating critical thinkers has become a focus for education institutions around the world in the recent decade, especially since it was identified as one of the most crucial abilities in the twenty-first century. This worldwide trend in education has sparked a surge in interest in critical thinking skills. Stakeholders, academics, and politicians agree that acquiring critical thinking skills are crucial for the social and economic advancement of countries around the world The purpose of the study is to examine the aptitude of critical thinking skills of high school students in grades 10 and 11. Students will perform a standardized test to assess their critical thinking skills. The test consists of 40 MCQs and its duration is 35-45 minutes. Your decision to allow your child to participate in this study is complete voluntary. If you decide to not allow your child to participate in this study, or to withdraw from participation at any time it will not affect the care, services, or benefits to which you are entitled. Your child's' responses to the test are completely anonymous and no names or other identifying information will be used when discussing or reporting data. Your child contribution to the study will be a helpful source of information for teachers and curriculum writers and for future education planning.

Please complete the form at the bottom of this letter and return it to the researcher. If you would like to receive more information about the study, please contact me at gilan.raslan@dnschools.com

Thank you,

Gilan Raslan

Master in Science Education

The British University in Dubai.

The respondent's email (**null**) was recorded on submission of this form. *
Required

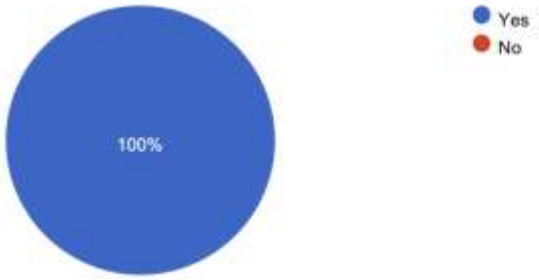
1. E-mail: * _____
2. Student/child's name: * _____

3. I have informed been with the purpose of the study and I I give permission for my child/student(s) to participate in the research being carried out by *Ms. Gilan Raslan* at The British University in Dubai. * Mark only one oval.
   - ◯ Yes
   - ◯ No

Appen

I have informed been with the purpose of the study and I give permission for my child/student(s) to participate in the research being carried out by *Ms. Gilan Raslan* at The British University in Dubai.

91 responses



Appendix 4 – Students' Acknowledgment Percentage of the Consent

Students' Acknowledgment Percentage of the Consent

I have informed been with the purpose of the study and I voluntarily agree to participate in this research study

91 responses