Perceptions of UAE Science Teachers on Effectiveness of Online Science Learning in COVID-19 Pandemic

تصور معلمي العلوم في دولة الإمارات العربية المتحدة حول فعالية تعليم مادة العلوم عبر خاصية التّعليم عن بعد في جائحة COVID-19

by

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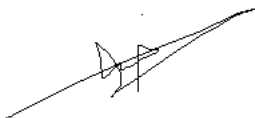**The British University in Dubai**

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Abstract

The UAE concentrates on maintaining a modern and smart educational development via the well-tailored teachers' professional development and students' support with needed skills to utilize technology. The UAE equips all local schools with all needed devices to implement technology and develop new strategies and approaches for the implementation of online learning as implied by the MoE projects and future strategies for education.

The current study was carried out to investigate the science teachers' and cycle 2 and cycle 3 students' perceptions regarding the preparedness and implementation of the online science instructions during the COVID-19 pandemic in Dubai private education sector. From a population size of 500, 218 were taken as sample size for teachers and students. The study investigated the science teachers and students' perceptions with regards to possible challenges faced during the science online instruction. This is a unique study which hypothesis stressed on the science online instructions for students and teachers in the school context. This research is a quantitative descriptive study using questionnaire methods conducted online for teachers and students. Two questionnaires were administered into the schools for cycle 2 and cycle 3 students and for teachers

Correlations and Regression tests were applied to meet the study' objectives. The relationship between the various variables were measured through the associative tests, correlation ship in the exploratory factor analysis, selection of the variables through regression, ANOVA and Chi Square Tests.

The results found that gender, nationality, and schools do play an important role in the online teaching and learning.

The study recommends that more schools must be added and tested for the study purposes. New types of participants to be involved and since the present study is focused exclusively on the quantitative lines, it is also recommended that qualitative research mist also be done to get the rigorous results.

<u>**الملخّص**</u>

تسعى دولة الإمارات العربية المتحدة على الحفاظ على تطوير التّعليم والسعي إلى الوصول إلى تعلُّم حديث وذكي من خلال التّطوير المهني للمعلمين عالي التصميم والتخطيط ومن خلال دعم الطّلبة بالمهارات اللازمة للاستفادة من التكنولوجيا. تحرص دولة الإمارات العربية المتحدة على تزويد جميع المدارس بالأجهزة اللازمة لتنفيذ التّعليم عن بعد وفق التكنولوجيا الجديدة، وتطوير استراتيجيات وأساليب جديدة لتنفيذ التّعلم عبر خاصية الانترنت كما هو متوافق مع مؤشرات ومشاريع وزارة التّربية والتّعليم والاستراتيجيات المستقبلية للتّعليم.

إن هذه الدراسة الحالية تهدف الى استقصاء وجهات النظر الخاصة بمعلمي العلوم للحلقة الثانية والثالثة فيما يتعلق بالاستعدادية لتنفيذ التّعلُّم عبر الإنترنت لمادة العلوم أثناء جائحة COVID-19 في قطاع التّعليم الخاص في دبي. إن العينة الكاملة لهذه الدراسة يبلغ 500 عددها، وتم قياس وجهات النظر ل 218 كحجم عينة للمعلمين والطّلبة. سلطت هذه الدراسة الضوء على وجهات نظر وتصورات معلمي العلوم والطلبة حول التحديات المحتملة التي تمت مواجهتها أثناء تعليم العلوم عبر الإنترنت. تعتبر هذه الدراسة فريدة من نوعها لأنها ترتكز على السياق المدرسي بعكس الدراسات الأخرى التي تعمل على السياق الجامعي. يعتبر هذا البحث دراسة وصفية كمية ،حيث تم أخذ استطلاع رأي كل من المعلمين والطّلبة من خلال استبيان أرسل عبر الإنترنت. حيث تم إجراء استبيانين في المدارس: الأول للطلبة الذكور والإناث الذين تتراوح أعمارهم بين 10 سنوات و 18 عامًا والذين يعتبرون طلبة الحلقة الثانية والحلقة الثالثة بحسب التصنيف الخاص بوزارة التّربية والتّعليم؛ والاستبيان الثاني لمعلمي العلوم و / أو منسقي مادة العلوم في بعض المدارس الخاصة التي تتبع منهاج وزارة التربية والتعليم أو أي منهج آخر.

تم تطبيق اختبارات الارتباطات والانحدار لتحقيق أهداف الدراسة. تم قياس العلاقة بين المتغيرات المختلفة من خلال الاختبارات الترابطية، وسفينة الارتباط في تحليل العامل الاستكشافي، واختيار المتغيرات من خلال الانحدار، واختبارات ANOVA وSquare Chi. كانت هناك فروق وانحرافات معيارية ومعاملات وتغاير ساعدت في فهم العلاقات المختلفة بطريقة إيجابية وسلبية. ومع ذلك، فمن خلال الانحدار الخطي المتعدد يفهم المرء حقًا دور المتغيرات. تم ذلك من خلال الانحدار التدريجي وساعد على تحديد وصياغة النماذج المختلفة.

من خلال الدراسات الوصفية، وجدت الدراسة أن جنس الطلبة وهويتهم يلعبان دورًا مهمًا في التدريس والتعلم عبر الإنترنت.

توصي الدراسة بضرورة إضافة المزيد من المدارس واختبارها لأغراض الدراسة. سيتم إشراك أنواع جديدة من المشاركين وبما أن الدراسة الحالية تركز حصريًا على الخطوط الكمية، فمن المستحسن أيضًا إجراء بحث نوعي للحصول على نتائج دقيقة.

DEDICATION

Every challenge needs self-effort as well as the support of people who are very close to our hearts, so it would be hard to reach for this achievement without their support.

I would proudly like to share my gratitude to my dear parents, to my dear parents who passed away during my research may Allah have mercy on them. They always encouraged and inspired me to continue my academic study and to complete this research.

I would like to thank my dear husband who supported me by all means to finish my study and to my dear daughters for being by my side during the entire journey.

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I am extremely grateful to my husband, my daughters and my son for their love, prayers and caring for educating and preparing me for my future.

Contents

CHAPTER 1

1.1   Introduction

Great challenges were brought to the society worldwide by the Coronavirus pandemic (COVID-19). The pandemic has drawn the attention to find solutions to different challenges related to education in the most creative and innovative manner (Kaushik & Agrawal, 2021). Thus, one may see mandatory changes in almost every aspect of human lives (García, et. al., 2021). Education was clearly affected by this universal worldwide COVID-19 (Lakhal & Khechine, 2021). Lawrie (2021) writes that more than 1.5 billion learners from all age groups from around the world are affected by the pandemic. Ninety per cent of the world's enrolled students were affected by the pandemic (Afrouz & Crisp, 2021). Face-to-face instruction and teaching and learning needed to be interrupted to reduce the chance of spreading the disease (König, et. al., 2020). Educators all over the world found that the online learning is a mandate and they found themselves forced to conduct their regular lessons remotely (König, et. al., 2020). Researchers today call this educational shift as the Online Emergency Remote Teaching that emerged as a response to the crisis (Ahamad, et. al., 2021). This shift has an undoubtable impacted the education quality (Akbar, 2021). A well-planned online learning experience and emergency remote teaching in response to a crisis or a disaster is not the same as the regular physical lesson that occurs in the classroom. Education sectors are working around the clock to maintain instruction during the COVID-19 pandemic while they need to ensure the remote assessment as well (Picciano, 2020).

Information and Communication Technologies (ICTs) provides for students and teachers a feasible and affordable access to different forms of educational subjects including textbooks, video materials and remote instruction (Abou, et. al., 2021). For the last decade, e-learning has proved to be a major support for teaching and learning methods (Korkmaz & Toraman, 2021). Fortunately, human neuroplasticity and adaptive behaviors made us natural in the era of digital technology, the internet connectivity, and all helped providing information, ensure communication and as a resultant provide education (Leś, 2021). The improvement of e-learning is closely linked to the advancement of technology and the ability to access different learning platforms with least difficulty (Albrahim, 2020). The e-Learning provides a form of digital

communication between teachers and students with the desire for effective communication (Armon, et. al., 2021). However, the e-learning has highlighted on unequal scenarios in the world as well as in the local context. Some areas, did not possess resources, which made their shift problematic (Al Darayseh, 2020). Every reform and any shift needs support and suppliance: students and teachers must be well equipped not only with the hardware and the software by with the needed skills to utilize these digital tools, understand them and tailor their online lessons plans (al Darayseh, 2020).

The chapter withhold through the different sections to investigate science teachers' and students' perceptions regarding their level of preparedness to the online science pedagogy during the pandemic COVID 19 in the private schools in Dubai (UAE). The current study will answer the following questions: 1) "What are the UAE science teachers' and students' perceptions about the preparedness and implementation of the online science instructions in Dubai private schools?" and 2) What are the challenges encountered with online science learning experience?" finally 3) What are the challenges that the science teachers and students encountered with online science instructions?

1.2 Background of the Research

With the wave of COVID-19 pandemic, tremendous changes have occurred to many aspects of life. These changes where found as a solution to overcome the possible negative impact of this sudden crisis (Llerena-Izquierdo & Ayala-Carabajo, 2021). The COVID-19 pandemic has spread in the entire world without the consideration of the sociodemographic characteristics of people, their race or their ethnicity (Chirikov, et. al., 2020). Yet, the impact of this wave was not the same around the world and differ between developed and undeveloped countries (Chirikov, et. al., 2020). Educational systems were clearly affected. Schools, universities, and colleges were shut down that forced the educational institutions to start experiencing Emergency Remote Online Education (Madsen & Cook, 2020).

Online distant learning is not new in the field of education (Campbell, et. al., 2021). A study entitled "issues in Distance Learning" published by Sherry (2013) mentioned that online learning existed for more than a century and had its earliest form in European correspondence courses. There is still no agreement in the literature about the time the term distance education appeared;

however, a statement we can hardly say that the first generation of distance education dates back to 1850s (Maican & Cocoradă, 2021).

Information and communication technologies (ICTs) are becoming more important day by day activating a change in the learning environment provided for education by its increasing power and capabilities. E-learning as defined by and is the purposeful use of electronic systems or computers in support of the learning process. Specialists believe that the proper use of E-learning technologies and online platforms can improve the learning environment of students, considering no time and space limit, students have better opportunities to collect information whenever they need or feel ready. Technology has been a great tool for education during the pandemic due to its increased robustness and ease of use (Ahamad, et.al., 2020). Comparing with the past, technologies permitted students to work more productively, yet the teachers' role became more demanding in technology rich classrooms (Martin et al, 2020; McCarthy, et. al., 2021).

ICT power is able to change the entire nature of education by enhancing teachers' design work, developing students' and teachers' role in the learning experience (Albrahim, 2020). Once used properly, the ICT promotes a collaborative learning environment, motivates students and provides them with a better accessibility to information and resources (Albrahim, 2020). Successful online education systems is measured by the level of interactivity between students and teachers, between students and learning environment or platforms, and between students themselves (Ahmad et. al., 2021). ICT, once effectively implemented, can modify the teaching and learning process in which students can invest their own knowledge in an active, independent, and productive way (Aškerc, et.al., 2015). ICT does not substitute the full existing teaching pedagogies, ICT is actually a key instrument to support new ways of teaching and learning (Kovacs, 2021).

The United Arab Emirates has always been ambitious about improving education. A project titled "Mohammad Bin Rashid for Smart Learning" (MBRSLP) launched in 2012 by H. H. Sheikh. Mohammad Bin Rashid Al Maktoum has changed the way the public schools deal with information (PMO, 2015). MBRSLP mission is to deliver world leading education technology solutions for the UAE education community in order to drive up the educational achievements, excellence and creativity of our students (UAE vision, 2021). The UAE vision 2021 that started in 2015, pursued sustainability and excellence in education and seek to prepare the Emirati

students towards the '21st century 'digital-age' where the coming generations will lead future economy' (Capili, 2021).

The UAE Ministry of Education has placed effort to provide a smart learning system and high-quality digital platforms, with constant development of the curriculum, an evaluation policy in the framework of measurement for learning, and focusing on providing the highest quality levels to reveal the best international practices (Dvurechenskaya & Strukova, 2021). The MBRSLP project reflects the early focus of the UAE country on online learning, and that it was present before the pandemic (Hiasat, 2021). This had made the country ready to establish a direct shift from face-to-face learning into online learning with high qualification soon after the occurrence of the crisis (Morreale, Thorpe, & Westwick, 2021).

The Ministry of Education of the UAE has come up with an e-maturity Framework to evaluate the effectiveness of the e-learning as well as students' and teachers' digital competencies (Mehta & Aguilera, 2020). The Knowledge Human authority who oversee the private schools in Dubai uses the same e-framework to assess the quality of the tools and solutions, digital content, devises and data analyzes used by the private schools in the learning process alongside with a sustainable infrastructure to achieve the change in people's attitudes, perceptions and assumptions that will make the real change (Mehta & Aguilera, 2020; Ministry of Education).

In parallel with the UAE vision, and the MBRSLP mission, the current study model will try to explore the views of the teachers and students with regards to the effectiveness of the integration of e-learning UAE model into the UAE private schools' curriculum, and the impact of the adopted teaching and learning.

1.3 Purpose & Questions of the Study

This current study is unique in its topic: Most UAE researchers investigated on the impact of the COVID-19 pandemic on higher education in UAE and discarded the basic education and what is the COVID- 19 pandemic impact on schools' teaching and learning. The findings of this study will present recommendations to support the local community in identifying the factors that can

hamper the effective implementation of science education in UAE during the pandemic. The study will give some recommendations on how to improve the online science education as a skills-based education. The COVID 19 has introduced the "Kuhn paradigm shift" of the new millennium in education. On one hand, there are teachers who are more trained and attuned to the traditional ways of teaching their students (Cerezo, et al., 2021). On the other hand, it required a pedagogical shifts from traditional classrooms to a new digital concept of teaching students through an online medium (Aderibigbe, Dias, & Abraham, 2021). This transformational mindset in teaching scenarios were not very comfortable to teachers in terms of planning, teaching, laboratory work especially in the science subjects (Anggraini, et.al., 2021). This uncomfortable situation touched not only the teachers, it involved parents, caregivers and stressed on the special needs cases (Anggraini, Jumiarni, & Ekaputri, 2021). The online learning raise up the quality of the teaching and learning that occurred in the classroom such as students' motivation, retention time, and made teachers work harder to create the learning opportunity that can ensure a learning happening (Barnes, Ramsey, & Dunlap, 2021). Examples used in the online learning in the Dubai (UAE) private schools was the google e-classrooms, the Microsoft Teams, or zoom. These social learning machinery once used as a tool for communication are now medium to teach and students adapted instantly and followed the trend (Reinke, et. al., 2021). Subsequently, a new architecture of the classroom emerged: instead of desks one after the other, the classroom is a rectangle of small windows where learning groups and closed chats and breakout rooms (Ishfaq, 2020).

It is with these changes and innovativeness; the current study is by itself an opportunity to reflect through serious analysis on the future of teaching and learning across UAE (Cutri & Mena, 2020) and maybe around the world. The novelty of the research topic and its sensitiveness in the region made us focus the sample into Dubai city and the private schools sectors only. The focus is to explore the UAE science teachers' and students' perceptions on their level of preparedness in the online science instructions in private schools, the challenges that the science teachers and students encountered with online science instructions, publications by faculty members and research scholars from various domains and countries who as well wrote about the challenges of the online learning (Richards, et. al., 2021) and Hassan (2021).

1.4 Statement of the Problem

Education is a fundamental element in the improvement journey of countries. For this reason, educators must cope with sudden changes in this field to correspond to the rapid development of the 21st century and to follow the speed of the improvement (Saleha, et. al., 2021). A big shift was made by the COVID-19 pandemic on how science teaching is implemented in classrooms in UAE schools (Moussa & Seraphim, 2017). A study conducted by (Hiasat,2021) found that the ways and strategies utilized in (F2F) face to face classrooms does not work in the online learning context and this was the views of most of the teachers. Therefore, new teaching and learning strategies and pedagogies must emerge. A transition to an approach from giving knowledge to guiding knowledge permits teachers to conduct the curriculum instruction in many different means and new ideas on using texts and multimedia allows students to interact with the course content (Aškerc & Kočar, 2015; al Darayseh, 2020).

Science is unique in the way it engages students and can be the core of an interdisciplinary context including technology, math, art and engineering (Ishfaq, 2020). Therefore, technology incorporation in learning environment such as simulations, videos, applications, and programming can ease and improve science attainment (Ishfaq, 2020). Along the change from traditional (F2F) learning to online remote learning, perceptions of science teachers and students differs regarding the preparedness and implementation of science online learning and preferences regarding platforms used to conduct science curriculum and possible difficulties faced with online experience (Muthuprasad, et. al., 2021; National Council of Teachers of English Executive Committee, 2013; Banihashem & Aliabadi, 2017).

1.5 Purpose and Question of the Study

The UAE concentrates on maintaining a modern and smart educational development via the well preparation of teachers and students with needed skills to utilize technology and schools with all needed devices and tools to implement technology, and developing new strategies and approaches for the implementation of online learning as implied by the MOE projects and future plans for education (David & Venuste, 2021). The UAE country aspires to adopt strategies that would encourage a culture of creativity and innovation by supplying students with twenty-first

century skills and inspiring them to have new ideas that come up with viable solutions to various problems, and bracing smart government (Omar, 2021).

Since the UAE is seeking excellence, competitiveness, and leadership in smart education and since the new situation implied by the pandemic; current researches and studies must focus on the field of online learning experience in the emirate schools during the COVID-19 pandemic (Glazier, et. al., 2021). This would perhaps find out how effective is the preparedness and implementation strategies on teaching and learning and would discover possible gaps and search for solutions to maintain the excellence UAE has already established (Taufik, 2020).

The main purpose of the present study was to investigate the science teachers' and students' perceptions regarding the preparedness and implementation of the online science instructions during the COVID-19 pandemic in Dubai private schools (del Arco, Silva, & Flores, 2021). It also investigates their perceptions regarding possible difficulties and challenges faced during science online experience (Garrison, 2017).

This study aims to answer the research questions "What are the UAE science teachers' and students' perceptions about the preparedness and implementation of the online science instructions in Dubai private schools?" and "What are the challenges encountered with online science learning experience?" and finally what are the challenges that the science teachers and students encountered with online science instructions?

There was no previous study was done on this topic in the UAE. Most of the studies aimed to investigate the impact of the COVID-19 pandemic on education in general in the UAE and many have focused on universities' learning instead of schools' learning. This study will help in identifying the factors that can hamper the effective implementation of science education in UAE during the pandemic and helps in overcoming the challenges and improve online science education.

1.6 Significance of the Study

The significance of this study exists in its early start after the emergence of the COVID-19 pandemic, so it traces and manifests the immediate effects on science education. It also adds to the existing literature in the field of science education and provides data for other researchers within the context of the global pandemic effects on science education. This study would provide

the Ministry of Education the needed data to explore gaps in the preparedness and implementation of ICT in online instruction and therefore, searches for new strategies to prepare science teachers and students and to properly implement online science instruction in order to overcome the impacts of COVID-19 on their teaching and learning capability. The current study gives science teachers and students the opportunity to reflect their opinions regarding science online experience effectiveness and to openly express the possible challenges and difficulties faced during their experience. It has been stated that the attitude of teachers is a major sign of the utilization of new technologies in instructional settings. Teachers' beliefs about using ICT in teaching and learning is of a great importance to integration. Teachers need to change their beliefs about their duty as teachers, the student's role, and learning nature to succeed in ICT use (Golden, 2020).

1.9 The Structure of the Study

This study is divided into 5 main chapters. In the First Chapter, there will be an introduction which highlights the topic choice and stresses on the importance of ICT use in education nationally and internationally. It also illustrates the background of the study, addresses the research problem, presents the purpose and questions of the study, and eventually it emphasizes the significance of the study. The Second Chapter demonstrates the theoretical framework and literature review in the light of the selected topic. The Third Chapter addresses the study methodology, nature of the study, materials and approaches used to collect data and the population and the study sample. Instruments, the research procedure and ethical considerations are also presented in this Chapter. The Fourth Chapter discusses the results, laying out the detailed summary of the analysis of the data and the key findings of the study. The last Chapter, Chapter Five, demonstrates the discussion regarding the results and states the conclusion as well as the suggestions, recommendations and limitations found in the research study.

CHAPTER 2: Theoretical Framework and Literature Review

This chapter consists of the study's theoretical framework and the literature review.

2.1   Theoretical Framework

This Section discusses theoretical frameworks that focus on the pedagogical aspects of the online education. Online education theories have moved from concentrating on structural and organizational obstacles to focusing on transactional (teaching and learning) issues (Garrison, 2017). There is no single theory for instruction and online education (Picciano, 2017). The functions of a good educational theory and its effect on education have been described by Wilson (1997): first, good theories help us look for the future and envisage new worlds. Second, good theories help us put words onto reality and execute things. Third, Wilson (1997) asserts that a good theory holds on to our sincerity. The three most popular learning theories are: behaviorism, cognitivism, and social constructivism, which made the roots for the evolution of several online learning theories. This section will focus on three learning theories concerned with the online education: i) The Community of Inquiry (CoI), ii) Connectivism, and iii) Online Collaborative Learning (OCL) theory (figure 1) (Garisson, 2009)
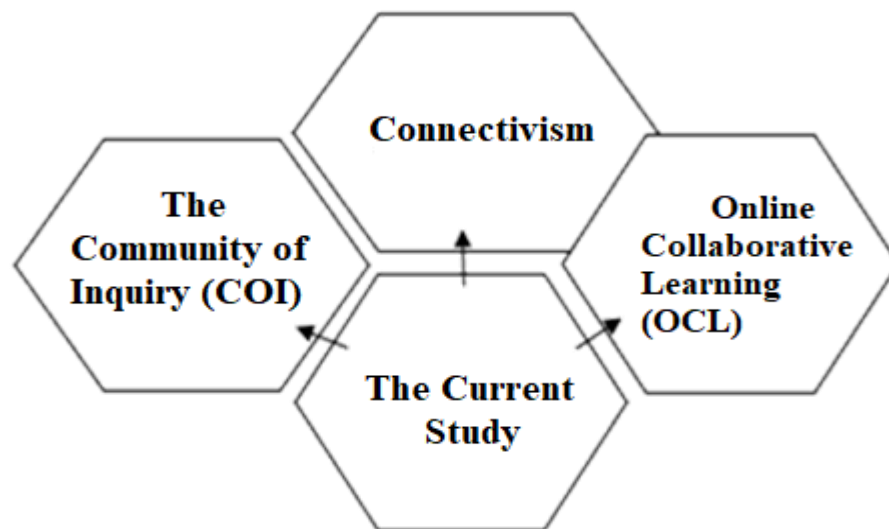
Figure 1. The Study's Theoretical Framework (Garrison, 2017)

2.1.1 The Community of Inquiry (CoI)

The COI model describes how learning takes place for a group of individual learners through the educational experience that occurs at the intersection of social, cognitive, and teaching presence (Vaughan, N., & Cleveland-Innes, 2020).
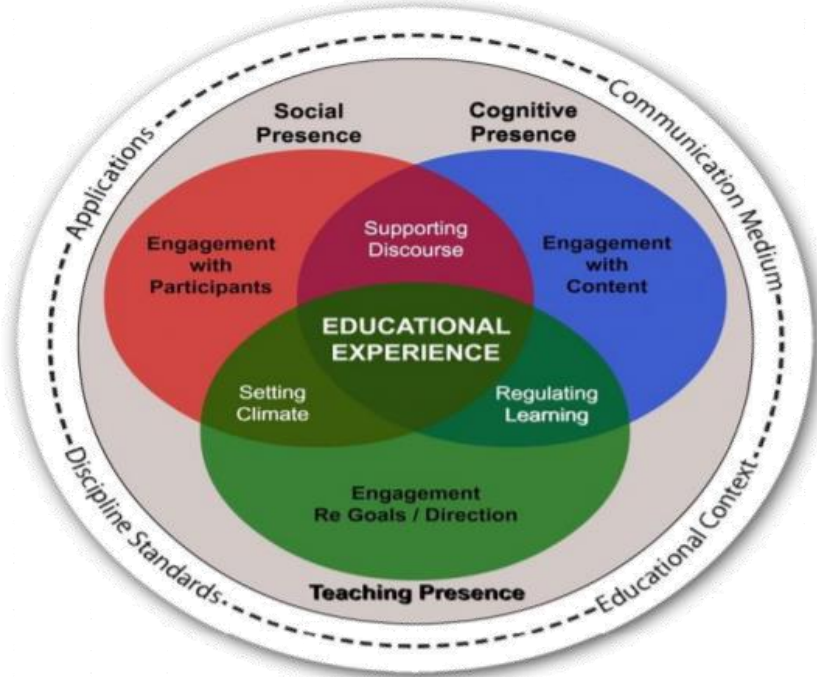
Figure 2. Community of Inquiry Model (Garrison, 2009; & Vaughan, N., & Cleveland-Innes, 2020).

In the COI, the student social presence is the ability to project his personality and to identify his own self while communicating with peers and developing interpersonal relationships (Garrison, 2017). In the COI Model, the cognitive presence is the extent to which learners can construct and confirm meaning through sustained reflection and discourse (Garrison, Anderson, & Archer, 2001, 2004). Teaching and learning in the COI online learning model is all about the design, the facilitation and how to direct the cognitive process of the learning outcomes attainment (Anderson, Rourke, Garrison, & Archer, 2001).

The current study follows the COI framework as it seeks the awareness of the learner on how he is actively managing and regulating the inquiry process in the online ecosystem (Vaughan, et al., 2020). It is all about the metacognition awareness and implementation of his knowledge in a collaborative online and blended environment through a critical communication and connection where he justifies his own thinking to self and peers (Vaughan, et al., 2020). The shared

metacognition construct reflects the co-regulation and the dynamic dimensions of the student in a strategic action function (Garrison, 2017; Garrison & Akyol, 2015a, 2015b).

2.1.2 Connectivism

Connectivism explains how digital technologies have created new opportunities for people to learn and share information across the World Wide Web and among themselves (Baldwin, 2019). These technologies include web browsers, email, wikis, online discussion forums, social networks, YouTube, and any other tool which enables the users to learn and share information with other people (Baldwin, 2019). The connectivism learning theory links the nodes together; these nodes are peers, tools to share knowledge. Knowledge and cognition are shared between both ends of the networking connected process (Banihashem, et al., 2017). In connectivism learning, the teacher unique role is to create an individualized ecosystem for the learner where digital tools are chosen carefully to answer their needs (Banihashem, et al., 2017). The extended format of the connectivism theory is the format of the open online course (MOOC) phenomenon (Banihashem, et al., 2017). The MOOC has been a trend after the pandemic and is considered as the safest node within the connectivism model (Banihashem, et al., 2017).

The current study falls into the connectivism theory as it tries to find how students' online assessment is a part of their continuous assessment activities and how the online learning process liaises learning within real-life contexts (Downes, 2012). The study embraces openness in education, online assessment practices need to be based on a more connectivism approach. Downes (2012, p.85) explains that "connectivism is the thesis where knowledge is distributed across a network of connections", therefore the current study seeks to find if the online learning has supported the students and gave them the ability to build and transverse those networks. The current study falls into connectivism as it will give us a better understanding of the online networking dynamics and the socio- technical context of the online learning in the private schools context (Jung, 2019).

2.1.3 Online Collaborative Learning (OCL)

Online collaborative learning (OCL) is a theory proposed by Harasim (2012) that focuses on the accommodations of the Internet to provide learning environments that foster collaboration and knowledge building. Harasim (2012) describes OCL as a new theory of learning that focuses on collaborative learning, knowledge building, and internet use as a mean to reshape formal, non-formal, and informal education for the "Knowledge Age" (Harasim, 2012, p. 81). Like Siemens (2009), Harasim (2012) recognizes the benefits of moving to online teaching and learning and the largescale networked education. In some respects, Harasim (2012) utilizes Alberto Barabasi's opinion on the power of networks. In OCL, we find three phases of knowledge construction through social, cognitive, and teaching and learning in students (Vaughan, et al., 2020). These cognitive constructs are couples with four main actions: the scaffolding, the participation in a critical discussion, the creation of a sustainable learning community and putting knowledge in action (Vaughan, et al., 2020). This means that students first generate ideas during a brainstorming phase, later they organize them and compare their concepts, analyze and categorized through discussion and argument, finally they perform the intellectual synthesis and consensus between each other agreeing or disagreeing (Vaughan, et al., 2020). The Online ecosystem is in favor of groups and teamwork to perform these activities either through an assignment, essay, or another joint piece of work (Harasim, 2012, p. 82). Unlike connectivism theory, which are suited for large-scale instruction, OCL is best situated in smaller instructional environments (Picciano, 2017). OCL also derives from social constructivism, where students are encouraged to collaboratively solve problems through discourse and where the educator plays the role as a facilitator for knowledge building (Picciano, 2017). Because of the importance of this facilitator role of the educator, OCL is not easy to scale up (Picciano, 2017).
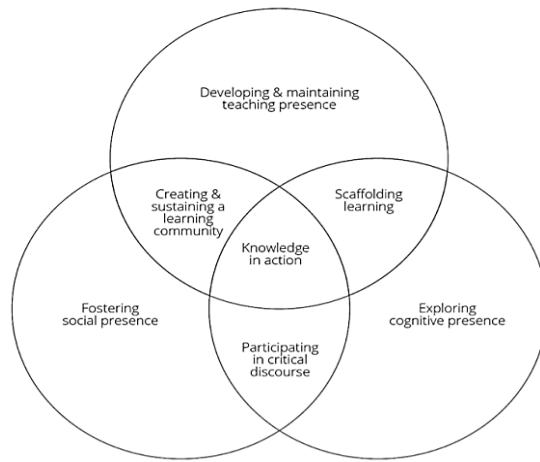
Figure 3. Online collaborative learning framework (Adapted from Garrison, Anderson, and Archer's community of inquiry model, 1999).

2.1.4 The Study Integrative Model
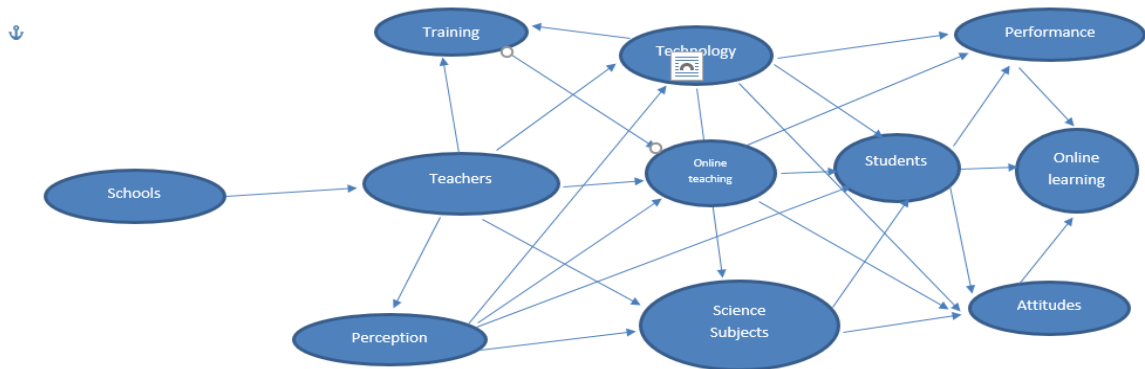
Figure 3. Online Education Model (Wilson, 1997)

It is true that all these theories are associated with the online education, it is appropriate to ask whether an integrated or unified theory of online education is possible. The current study still novice, might be using the three theories joined together: teachers and students who were new to the online learning were moving in a trial-and-error process and might have used all of

these theories or even none. The Model above advised by Wilson (1997) determines the Independent and Dependent Variables of the current study. Table 1 below gives the details of the variables identified for the research work (See Appendix Table 1). The variables selected and identified for the present study are Schools (Independent Variable), Teachers (Independent Variable), Professional development called Training (Independent Variable), Perception (Independent Variable), Technology (Independent Variable), Science Subjects (Independent Variable), Students (Independent Variable), Performance (Independent Variable), Attitudes (Independent Variable), Online Teaching (Independent Variable) and Online Learning (Dependent Variable).

The Theoretical framework of the study joins all the three concepts to describe the online learning in the UAE during the shift towards the remote learning. The COVID19 pandemic has allowed families and institutions to acquire new and valuable ICT skills and family communication between family members has increased and got re affirmed through an online collaborative learning for all (Erfurth, & Ridge, 2020). It is true that the pandemic has created socio-economic groups between private and public schools especially that most of the support came to public schools' students (Erfurth, & Ridge, 2020). ….It is worthwhile to note that there are missing gaps for the objectives of the study. For example, one of the papers pointed out that one must develop an objective like "To study the comparison between the old common core standards and Next Generation Science Standards (NGSS) from the perspective of the teachers" (Aderibigbe, et. al., 2021). Apart from this, there was insufficient professional development, the role of the teachers in designing the curriculum, and a lack of leadership in the areas of administration (Reinke, et. al., 2021). Thus, it was felt that there is no dedication towards the subject and integration.

2.2   Literature Review of Studies

The literature review withholds the essential gaps in the study. The review of the latest articles and reflecting on the current UAE context supports the science of knowing the e-learning efficiency techniques used for the analysis, and observations. Subsequently, the literature as well will identify the variables as well as the rationale of the questionnaire questions building and the theory behind its conceptual models.

2.2.1   Online education system preparedness during the Pandemic

The situation in the UAE was not far better than all the world. Parents and teachers in the UAE have stressed the need for teamwork to ensure first the success of the remote learning and at a later stage its efficiency (Sircar, et al., 2020). Early research indicates that students throughout the country are unequally impacted by the immediate shift to the remote learning depending on the social factors (McKinsey & Company, April 2020). For instance, before the pandemic, online platforms were already at 60% of implementation in the private and the public sector (Sutton Trust, April 2020). the UAE's Responses to COVID-19 in the Education Sector was immediate through a roadmap for distance learning implemented in public and private schools using a 'Smart Learning Management Platform' used by parents, teachers, and students (Erfurth, & Ridge, 2020). While online platforms are available, home contexts are also crucial for students' ability to learn. Students' resources such as computers and internet and low-income families that affect space and support, both were a real concern (Erfurth, & Ridge, 2020). As all students around the world, some of the UAE students were more comfortable dealing with the online classrooms because they had challenges with the maturity of their soft skills, such as communication, teamwork, peer discussion, public phobia (Dvurechenskaya & Strukova, 2021). Students with special needs and diversified academic plan struggled throughout the e-learning and teachers needed specific smart education tools to optimize the remote learning reach and efficiency example touch screens, voice detectors, proctoring systems (Sircar, et al.,2020). We can say that the UAE schools were prepared but not ready (Sircar, et al., 2020).

UAE schools are advised in the future to put necessary measures in place in case of pandemic such as emergency learning kits and various mediums of instruction tailored to the diverse needs of their students, particularly those with low socioeconomic backgrounds and special needs (Erfurth, & Ridge, 2020). When technological solutions are implemented regularly as teaching activities, and future transitions will be smoother; however, this would need to include continued investment in resources and training (Erfurth, & Ridge, 2020).

2.2.2 UAE experience in the Online Teaching and Learning

Teaching skills and requirements changed for the last decade. Learning outcomes are not cognitive solely but depend on personal, interpersonal, and behavioral and [after the COVID19 it turned out to be even more] economic development (Albrahim, 2020). Bell et al., (2013) argue that online learning support students with health issues that prevent them for attending classes and can offer higher education students cross- cultural experiences opening students to new cultures. However, feeling anonymous with a lack of identity is an issue for some other learners (Albrahim, 2020). Online teaching needs strategies and pedagogies that are specific for the online context (Mehta & Aguilera, 2020), UAE teachers had not only to adapt their teaching approaches but as well edit their content to fit students in the online discussions (Aderibigbe, et. al., 2021). Studies from a survey that studies teachers' preparedness in the UAE show that majority received less than a day of formal professional development of distance learning and more than forty-seven per cent did not receive at all (Erfurth, & Ridge, 2020). Even though teachers in the public schools received more training than the public schools' sectors, the teachers still felt prepared for the online teaching and learning than the public schools' teachers (Erfurth, & Ridge, 2020).
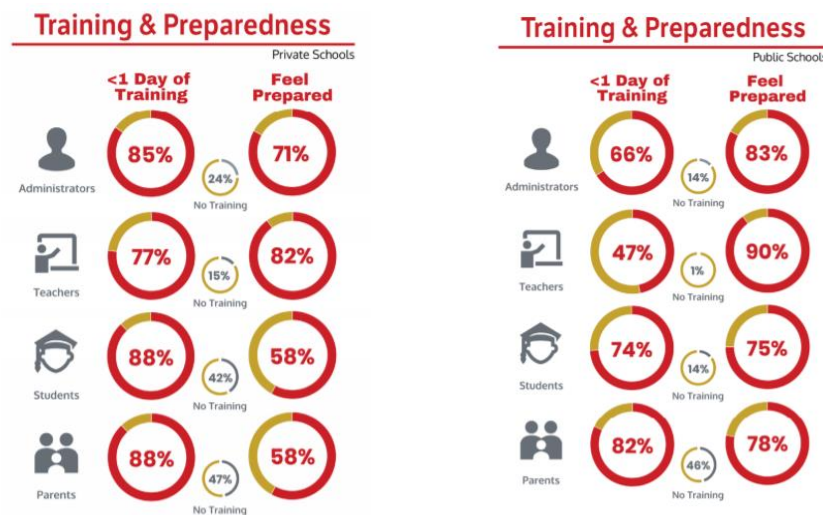
Fig 1: Formal Training and Preparedness at Private Schools and Public Schools UAE (Erfurth, & Ridge, 2020).

The UAE is always trying to offer its students an environment where they can flourish through a formula of benefits (Omar, 2021; Saleha & Shakerb, 2021; Aderibigbe, et. al., 2021).

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Furthermore, the Gulf country has stretched hands to reach all private sectors' providers to empower the experience of the online education and offered two frameworks coupled with the teaching and learning: Aqdar for cybersecurity and the Students' wellbeing in the eLearning ecosystem (Abou, et. al., 2021; Akbar, 2021; Armon, et. al., 2021; de Moura, et. al., 2021).

The COVID19 showed a discrepancy between schools leaders in the region with regards to the level of involvement within their schools' environment and the level to which they have prepared their academic staff for urgent change such as the curriculum reform, the sequence, the pedagogy (Saleha & Shakerb, 2021).Schools in the UAE, who were starting their transition to online during the pandemic faced tremendous challenges. The Ministry of Education introduced the e learning inspections framework and added stress and source of uncertainty for teachers who were contributing to long working hours, especially teachers from the private sector who felt outside of the public authoritarian system (see also Nasir, 2020a). In this context, teachers felt that these inspections are focusing a rigid checklist rather than encouraging much needed flexibility. While teachers understand the importance of unannounced visits, they did not understand the main objective of the online visits and the rationale of the classroom evaluation and what does it assess: they only had received less than one day of training to be where they are now (Erfurth, & Ridge, 2020). Some teachers were skeptical and did not take the evaluation seriously: some inspectors considered answering at the same time as loud, others as interactive with the teacher. Understandably, teachers will feel that the assessment tool and people are not a fair assessment and that their hard work is not appreciated (Erfurth, & Ridge, 2020).

2.2.3 Effectiveness of the online teaching and learning Implementation

In this globalized and digitalized century, governments are encouraging the online learning and names such as "blended" and "online" learning have been a trend for the last 12 months of the year 2020 (Hergüner, et. al., 2021). Online education, regardless of gender has increased motivation and positive attitudes towards learning between students (Atanga, Jones, Krueger, & Lu, 2019). The Online learning is a topic that has been in discussion in various papers, and some authors relate students' computational thinking skills empowerment to the blended learning regardless of the students' gender and cognitive levels (Hergüner, et. al., 2021). Students in higher education enjoyed the online learning and they were positively involved in their sessions and this reflected a positive cognitive behavior (Maican & Cocoradă, 2021). It all

depends on the scientific content and the practices used; some non -STEM students perceive the online environment as a content centered field with lack of real practice (Maican & Cocoradă, 2021). The diffusion of the digital learning platforms makes the students more optimistic and innovative with regards to technology (Kaushik & Agrawal, 2021), and Osmani (2021) asserts that the online learning gives students learning satisfaction.

A research conducted on 380,000 students on the effect of online learning on students' time management and completion, showed that students managed their time better when they are not bonded by the time, space and pace and they completed their tasks on time regardless of their gender (Veletsianos, et. al., 2021). Several other concepts and perception differences amongst the gender (Muthuprasad, et. al., 2021), the persistence of the students towards technology (Lakhal & Khechine, 2021), variability in the gender for the e-learning essentials (Yawson & Yamoah, 2021), moving towards the lifelong learning mode (Thongmak, 2021), differences in the gender concerning the workplaces (Richards, et. al., 2021), gender variations concerning the special educational needs (Laamanen, et. al., 2021), mixing of two forms of face-to-face teaching and online learning for the women and men (Glazier, et. al., 2020), and learning outcome differences in the gender (Chirikov, et. al., 2020).

There is a gender difference in the students and academicians' performances in distance education, female performed better in terms of academic performance and self-efficacy however they were less involved in the classroom engagement versus their male peers (Perkowski, 2013). Furthermore, the analysis of the students' satisfaction for the online learning tools and the blended learning showed in the Middle east region a non-significant difference between physical and blended learning for both genders favoring even more the blended learning (Osmani, 2021). With the discussion on "gender and online education in UAE", there are few studies available and focused exclusively on the "transformative learning in UAE women" in higher education. The information and communication technology are more used for learning purposes and social media by female more by male, however both male and female show the same patterns in using the technology in their lives (Moussa & Seraphim, 2017). Madsen and Cook (2020) stressed that women are more acquainted to moving towards the e learning shift in the higher education context in the UAE for cultural reasons and distance challenges (Madsen & Cook, 2020). There is a dichotomy between what the UAE policymakers are seeking for with regards to the quick

shift towards the e-learning and what the young students perceived to be useful for them (Gokah, 2015). Students find the online classes and their flexibility a much attractive option; however, they reported the lack of teacher's preparedness who did not really understood the pedagogy of the online ecosystem (Muthuprasad et al., 2021).

The Equity in access to online learning has been a major concern in the UAE and the region especially for underprivileged communities who have limited or no access to free internet, electricity, computers, tablets, and other devices (UNESCO, 2020). To ease the disruption, the UAE and Iraq including KRI created a hotline for teachers and students to seek technical support if they face any difficulties. This study is unique as it stresses on early childhood learning views and perceptions with regards to the online eLearning, parents' role in the online learning setting. The UAE has tried to support working parents during the online learning and until the present time of 2021, if the parents have children following the distance learning they can work from home (MoE, 2021). This specific concept can be another extended study after the current one. The lack of parental support for online learners can be problematic for young learners and will impact of the effectiveness of online learning also (Saleha & Shakerb, 2021).

3. Conclusion

To conclude this literature; education practices have changed due to the COVID19; the sudden mandate to own a flexible digital learning management system, new innovative solutions to support the paper-based textbooks, the investment in innovative digital technology resources, and the idea that teachers need to be in distance with regards to their students and how the literature has changed (Korkmaz & Toraman, 2021). Teachers' perspective has changed during the online teaching as they have re- evaluated the value and support of their own institutions during the pandemic. McCarthy, et al. (2021) pointed four standpoints listed by teaches: mutual benefit, incompatibility, compromised teaching and learning and finally reservations, and according to that some teachers have changed their pedagogical beliefs and their approaches during the online teaching. Indeed, the infrastructure played a very important role in the science virtual classes. Training teachers was important in the scenarios of the online teaching and various platforms available and the simulations and their uses in their digital classroom

environment (Perkowski, 2012). Some teachers needed even further a support in the basic computer skills and then the pedagogies of the online learning (Perkowski, 2012). This raised another query which is the integration between the teachers' technical skills and the efficient implementations within a learning context of the available digital tools (Saleha & Shakerb, 2021). In other words, one needs to see the effect of online learning and the various pedagogical skills of the teachers for teaching in online education. Another question that was recognized for the hypothesis was "can teachers give full delivery of the curriculum and maintain the innovative practices" in their teaching in the online mode or not. It was necessary to understand the relationship between the ICT infrastructure and the presence of the teachers in online education (Albrahim, 2020). The subject area is a challenge by itself in the online learning and requires expertise: the subject of biology, chemistry, and physics require workplace and laboratory setting; in higher advanced education in sciences students require broader and more advanced concepts (Reinke, 2021). Higher education students need supportive resources based on animation and 3D simulations to understand complex concepts in Biology, chemistry and physics (Reinke, 2021). Other authors stated the same ideas such as (Afrouz & Crisp, 2021). Maybe financial liquidity needs to be available as well in the private sector and review the teaching hours and schedules distributions and thinks about education flexibility instead for students and give them the choice of learning and applying all learning theories related to Project-based learning that will provide an opportunity to learn integrated subjects working on a dedicated community social need and challenge (cf. Lenz et al., 2015).

CHAPTER 3-RESEARCH METHODOLOGY

3.1 Introduction

The research methodology, is an integral part of the analysis, focusing on the research methods. It helps to understand the research methods, techniques, designs, and steps in undertaking an analysis. To put it! another way, it serves as the basis for planning and designing the whole research project. For instance, one may want to introduce the philosophical assumptions, participant descriptions, population information, the ample size estimate, appropriate techniques, and tools for the study, etc. As a result, the methodology chapter proves word choice to be informative in terms of research methodology (Scandura & Williams, 2000; Kothari, 2004); it includes participants and respondents' details, a brief orientation to the philosophical assumption adopted for the research study, the materials used for the research, the approach for the research study, the essential research objectives the research model, steps for data collection and the population sample choice. It includes the data collection and ethical considerations as well.

3.2 Research Design

Many philosophical assumptions Thomas Kuhn (1962) is the first author who used the word: "paradigm" which means the philosophical way of thinking (Ishaq, 2020). The term paradigm, represents fundamentally in the current research the quantitative variables and the views of the teachers and students about how they see the online learning effective with regards to the high learning quality in which she/he lives and wants to live. The current study belongs as all scientific studies mainly to logical positivism as the main research philosophy. The positivism design will support the current research study as it will look in depth at the causes behind the research problems and contributes to understanding and knowing the principles behind its

occurrence Johansson, 2021). It is an approach to analysis that is theory-free aiming to generalize

objectivity and reach the truth (Johansson, 2021). The choice of sampling size of the current

research falls into the criteria of population coverage for such as design as the sample of the

current research is a large number (Ishfaq, 2020). This current research has been unique in how it

was adapted from a very big data sets to a smaller data sets, and regions, calculation, and data

analysis: all of these are linked to logical positivism. Results and quantitative findings of the

current study falls into the logical positivism and deductive reasoning research strategy that will

explain truth behind the data analysis and ends up with credible and valid conclusions (Hasan,

2016). As a result, the present study is a mixed method with deductive reasoning. This seems to

be appropriate with the logical positivism paradigm, as truth will be deducted through the

answers on the questions identified by the population selected sample size exclusively to answer

the purpose of the study.

The current study belongs to the post positivism paradigm for several reasons. Positivism is a

reliable paradigm for factual experimentation and quantifiable data using statistical tests in a

deductive strategically method such as questionnaire and later analysis through SPSS or other

quantitative tools for analysis (Roger; & Williams, 2010). The primary considerations for

choosing it is based on the purpose of the research and its credible philosophical assumption for

research purposes that involve questionnaires and surveys (Leś, 2021). The logical positivism

research is highly structuralized by design and ideal for data settings that include a lot of

variables and the current study includes a large population of students and teachers who belong

the private schools and we see that it fits the current study. The current study is a quantitative

research design as it involves deductive reasoning through students and teacher's questionnaire,

that are be coupled with qualitative tools such as interviews and surveys - if the data collection

did not answer the questions alone - (Creswell, 2013). In this respect, logical positivism is highly adequate for this current research study offering both qualitative and quantitative methods to carry out a research analysis (Creswell, et. al., 2007); This type of research design is called a mixed-methods approach which includes triangulating the data to reach the answer through observation, evidence and tools that will lead to your answers which is not the current case of our study (Creswell, 2013). The current study is similar to biology laboratory research methods based on gathering information in a case study analysis and can be applicable to the current study focusing on science instruction delivery (Reinke, et. al., 2021).

Finally, the current research will reflect the independence of the observer, the irrelevancy of human interests, the demand for causality demonstrations, the progress of the research through appropriate hypotheses and deductions (Frankle, 2020). This in a simple term will lead to generalizations following the credible statistical probability (Frankle, 2020).

3.4 Research Site work

The study requires to cover different schools to survey with the questionnaires of the online learning. The study research sampling expected to cover all the UAE territory, however, the schools did not feel comfortable sharing their experience with regards to the transfer of the teaching and learning from face to face to online learning. Some schools totally rejected the proposal, some others accepted at first but after looking at the questionnaire's questions refused to be part of the current study. Our research site under investigations is limited to the schools that are private in the Emirates of Dubai, yet these private schools are following the Ministry of Education Curriculum and governance. It might be one of the reasons as well behind taking part of the current study either fearing accountability or that taking part of the study will affect their inspection results or evaluation if the results of the research are not positive as they should be.

So, after around three months seeking the candidates, Dubai UAE schools' principals and head of departments accepted to take part of the data collection. Questionnaires were sent to the students with their own choice and willingness to participate in the research. However, it was found that most of them did not wish to volunteer into participating in the questionnaire. Apart from the students, the science teachers were also requested to participate in the questionnaire. There were few of them to take the initiative and be part of the current study may be appropriate for sampling of ethical or limitations It might be that the online learning views and perceptions are still not mature enough to be shared or that students and teachers are still confused with regards to using the online learning in their teaching and learning. The student's and teachers' identity remained confidential, and questionnaires were kept anonymous. Despite that, participation remained timid and few.

3.5 Study Procedure

The questionnaires were sent to the volunteers through an online automated link, data was collected from students and faculty members from different schools in Dubai and the questionnaires' data collection was finalized within one month. Once the schools granted the collection of the data, the questionnaire link was shared with the participants through the school administration (covering both teachers and students). The respondent's sensitive information such as his social context or any history of convictions were not required in the questionnaire and answers remained confidential and will be used for the current research purpose only. The questionnaires were gathered in a folder protected by a username and a password that only me the researcher knew, and responses were recorded in the Excel Sheet Version 2019. This helped in two ways: first to covert the files to sav format and to be used for further analysis in IBM

SPSS Version 26" and second to perform and draw various visualizations in MS Excel Version 2019 itself if needed.

Table 1: Variance and Standard deviation of the variables too many detailed variables…any cluster? Again, move with instruments (Questionnaire section)

S.No.	Label	Variance	Standard Deviation
1	**Gender**	0.23	0.48
2	**Nationality**	0.23	0.48
3	**School Emirates**	0.51	0.71
4	**Phase**	0.23	0.48
5	**Class**	1.08	1.04
6	**Learning product**	2.03	1.42
7	**School ICT device**	0.93	0.96
8	**School Provided ICT**	1.73	1.32
9	**School Support Data bundles**	1.29	1.14
10	**School Professional Support**	0.82	0.90
11	**Access Use**	0.62	0.79
12	**Technical Skills Expert**	0.97	0.98
13	**Critical Creative Thinking Skills**	0.86	0.93
14	**Increase Self Confidence**	0.86	0.92
15	**Effective Learning**	1.20	1.10
16	**Gap teacher and student**	1.21	1.10
17	**Online Learning better**	1.77	1.33

3.6 Questionnaires:

This research is a quantitative descriptive study using questionnaire methods conducted online for teachers and students (Sugiyono, 2017). Questionnaires are among the most common research tools in virtual reality (VR) and in online learning case studies (Alexandrovsky, et, al., 2020). Transitioning from online learning for giving self-reports alone through discussions can lead to systematic biases, therefore may ease participation and avoid biases (Alexandrovsky, et, al., 2020).

Two questionnaires were developed, adapted, tested, after being modified they were finally administered into the schools: the first one for students male and female aged between 10 years and 18 years that are considered as Cycle 2 and Cycle 3 students in the Ministry of Education guidelines; and the second questionnaire for science teachers and / or science coordinators in some private schools following the MoE curriculum or any other curriculum.

The science teachers' questionnaire consists of 35 questions divided into eight sections or domains. The first section is composed of 5 items, where questions aim to determine the characteristics of the participants including their gender, the level of education that work in, experience in teaching, workplace emirate, and subject area of expertise. The second section is about the impact of accessing ICT infrastructure on online science learning and is composed of 5 questions as well that focus on the effective use of technology within the online learning and the inclusion of technology in the new pedagogy of the classroom. The third section investigates the online platforms that they have preferred to teach science with and the resources preferably for sciences and it is one item. The fourth section items address the level of preparedness of both students and teachers for online learning teaching and using as a tool for learning and is composed of 4 items. The fifth section aims to investigate the effects of science teachers' competencies on online learning and is composed of 4 items to evaluate the effective learning community and does this community expresses its reason for being, its aspirations as an online learning community**.** The sixth section is about science teachers' perception on use of ICT for science teaching and learning and is composed of 8 items and makes sure to reflect on the shared understanding of online learning for the teachers and to what extent they cater: the intellectual, personal, social, physical, and affective characteristics to be nurtured in students. The seventh section is addressing the challenges encountered with online science learning and is composed of 8 items and an open-ended question in the eighth section.

The students' questionnaire consists of 32 questions in seven sections. The first section consists on general information to identify the students cycle as it will affect in the analysis, and the identity remains confidential. The second section is concerned with the online hardware such as what type of devices are used by the students in the online learning session and that is only one item. The third section tries to identify the level of students' preparedness for online learning and their well-being is one of the main concerns, and this section is composed of 4 items. The

fourth section is to address share the students' views on the development of their competencies during the on online learning and what could be these skills developed if there is any; this section is composed of 2 items. The fifth section aims to investigate the students' perceptions on the use of ICT for science learning and if they view its use as legitimate for their own mindset and own growth and is composed of 5 items. The sixth section is to investigate which preferred platforms are they using and is considered as the best to develop learning and is composed of 1 item: and the last section is addressing the challenges encountered with online science learning and is composed of 5 items.

3.6 Sampling and Participants

Population first! Since the research is focused on online learning, the participants were primarily classified as "Pedagogue from various Schools" and "Students or Learners." The information of the students and teachers who were classified and chosen for the survey was divided into two data sets in the report (Rashid, et. al., 2020). The first group consisted of 500 students from Dubai, UAE schools. Even though every effort was made to include as many students as possible in the report, the actual turnout was lower than expected since most students were not willing to take part of the study. The second group consisted of 100 Science Teachers from several Dubai Private schools following the MoE Curriculum in science that were questioned at stages as soon as we received their approval. Even though the goal was to include as many teachers as possible in the study, the total number of teachers who participated was lower than expected and we had to go through several trials to reach the twenty percent required population size (Creswell, 2013). Furthermore, the sample of the population covers only the Emirate of Dubai. More concerning the population and sample size calculation for the respective study.

For the present study, the population sample taken from the selected research site is 500 candidates which is around twenty percent of the whole population of the Dubai Emirates

(Creswell, et. al., 2007). The current quantitative mixed method study has a margin of error as 5%, therefore the real value was within plus or minus 2.5% of the measured or surveyed value meant for the study (Creswell, et. al., 2007). The level of confidence is considered as 95% for the simple reason that even if we collect the 500 questionnaires, we still did not cover the full UAE country. There are 35 questions for teachers' analysis, and 22 questions are for students' analysis (Creswell, et. al., 2007).

Though the total number of schools covered in Dubai, UAE, it must be remembered that the turned-out number of students was significantly less. However, this also helped capture the schools, teachers, and students exclusively from Dubai schools, UAE. This ensures that the truth and objectivity are being achieved for Dubai, UAE. Moreover, the population size, limited to 500 for the present research study might not support a generalization of findings, only a starting point for further analysis. The present study was conducted in the schools wherein the students and teachers participating are respectively following the science instruction or science teachers. One of the questionnaires was sent to science teachers and the other for students. Questionnaires were designed exclusively for quantitative analysis that will support a clear and strong association among students and teachers (see detailed questionnaire in appendixes).
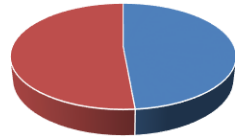
Table 2: Count and Percentage of Gender

S.No.	Gender	Number	Percentage
1	**Men**	77	35.16
2	**Women**	142	64.84
	Total	219	

Table 3: Count and Percentage of Nationality

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S.No.	Label	Count	Percentage
1	Not Emirati	81	36.98
2	Emirati	138	63.01
	Total	219	

Table 3.1: Sample Distribution

	Number	Percentage	
Teacher	207	48.59	
Students	219	51.41	
Total	426	100	

Sample Distribution

3.7 Instrumentation

No standard instruments were used for designing of the questionnaire, rather it is developed by the researcher from previous research. Studies and through the gaps and missing links (Hergüner et a., 2021; & Chirikov et al, 2020). In other words, no scales were adapted or adopted to design the questionnaire. Various research tools are used for the study viz. IBM SPSS Version 26 (Descriptive Statistics) (Regression and Correlation), MS Excel Version 2019 (Visualizations of Charts and Graphs), IBM AMOS Version 26 (SEM and Regression), and WEKA Version 3.8.5 (Data Mining). The questionnaire includes questions and answers would be given within a Likert scale system that move from strongly agree and strongly disagree. Questions covered domains of

effectiveness of the online teaching and learning, teachers' preparedness for such teaching

approach and students and teacher's views about the science teaching and learning support. The

figure 5 below shows how the data was collected and classified and analyzed describe the

questionnaire and its clusters, if any? With whole questionnaire in appendices.

The School Ensured I have a laptop or any ICT device to use?			
No.	Label	Count	Weight
1	Strongly Agree	57	57.5
2	Agree	104	104.0
3	Neutral	37	37.0
4	Disagree	8	8.0
5	Strongly Disagree	8	8.0

Data gathered through the Likert scale & counted along with answers'

The analysis of each data collected through a questionnaire had to go through an in-depth
analysis to find a correlation between each variable and the other, i.e., how does a lack of school
professional support affect the teachers 'effectiveness in their online classroom delivery and can

be different per gender, per classes, shown in figure 6. This quantitative analysis and more will be analyzed.

Figure 6 Correlation between School professional support and online teachers' delivery and Gender

3.8 Validity and Reliability of Study
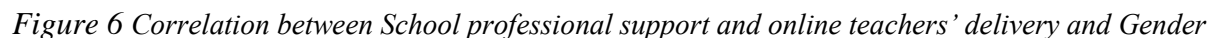
For the present research, the different techniques identified for the analysis are Conducting

Exploratory Factor Analysis and CFA. This step helps in identifying various factors and the

formation of different constructs in the study. Moreover, the step for testing CFA present it here?

Is necessary to check the validity and reliability of the dataset. Descriptive Statistics covering the

univariate, bivariate and multivariate analysis is conducted to test the following checkpoints in

the data set for further analysis. In this step, there will be simple steps to see the Linear Graph

for checking the linear relationship amongst the variables; mean, median, and mode; frequency;

count and percentage; standard deviation and variance in the data set. Apart from these steps, one

may also plot the bar graphs, histograms, box plots, and scatter plots. To Identifying the

relationship between the bivariate and multi-variate variables, it is necessary to note whether the

relationship between the variables is Linear or Curvilinear. Accordingly, one may proceed

further to the next step to test for the bivariate or multivariate relationships. The relationship

between the variables will be going through the tests of the correlation and regression. Under

correlation, one may note whether there is a positive or negative correlation, or the variables are

present in the same direction or not. Under the regression, tests will be drawn upon the linear

regression followed by the multivariate regression. These steps will help one to make future

predictions about the model. Under the SEM, the measurement model will be tested for

reliability, validity, and model fitness. On the other hand, under the structural model, the

relationship will be understood through CFA and regression inadequate. There is an additional

need for a reliability table or/and description for the questionnaire tool in order to specific

validity checks for the used data collection instrument in order to consider the results are viable

and applicable and even extendable to be a starting point of future research (Creswell, 2017).

3.6 Data Analysis

After collecting research data from (now) participating schools in Dubai coding were recorded

and noted in an Excel spreadsheet, and the data was ready for analysis (Szlávi, & Zsakó, 2003).

The quantitative analysis method, i.e., deductive reasoning, was used in the study. The following

research techniques were identified for the current study: data cleaning, data processing, and data

analysis. Checks such as "Was there any missing data?" and "Was the respondents' responses

correct or incorrect?" can be found in the data cleaning process Szlávi, & Zsakó, 2003). On the

provided data collection, and "Whether the responses were completely completed and submitted

properly or not?" are performed. After checkpoints were completed, some additional

measurements were to be observed in the results (Szlávi, & Zsakó, 2003). It should be noted that there was no manipulation of the collected data, that no items were omitted from the data, and that no items were copied and pasted, i.e., no fake data was generated for further stud (Szlávi, & Zsakó, 2003). After completing the data cleaning phase, it is necessary to continue with the data processing or data mining steps. These steps verify whether or not the data is correctly scaled up. It is worth noting that this move includes data visualization. This allows you to have a better understanding of the data and prepare for the other quantitative methods that will be used in the study. Furthermore, it is beneficial to understand the essence of the variables, such as "whether the variables are numeric or categorical in nature?", "What can be added about the distribution of the variables?", "What is the relationship between the variables?" and "Whether the variables are discrete or continuous in nature?"

With the assistance of data visualizations, we have proceeded with the standardization and normalization of the data—this aid in ensuring that the variables' units are consistent throughout the study's data. Second, the variables' values range from 0 to 1. This could be investigated further using the mean and standard deviation values. Once the data has succumbed to the data mining processes, the next step will be for the data analysis.

The quantitative data of the questionnaire are related to numbers and frequencies while the qualitative ones are related to perceptions and views that usually are subjective. In this current study we have used quantitative tools and the analysis of the views of the students qualitatively.

3.12 Ethical Considerations

Confidentiality is a crucial point in any data collection especially if the research is done with students and teachers considered vulnerable participants (Creswell, et al., 2017). The current

thesis data collection as a challenge to be conducted in the federal government sector, even in the private school's environment. What makes it more challenging is that will highlight challenges of a new practice considered a success (National, 2020). Getting the data and their analysis is highly dangerous and therefore, all results and data collected from the field or from the schools does not include identity, and content of the questionnaires process are protected, and answers are anonymous. All ethical considerations were adhered to follow the guidance issued by the the British University of Dubai. Furthermore, ethical standards are adhered to in the following areas Voluntary Participation, Informed Consent, Confidentiality, Anonymity, potential harmful points, and communication results (Connelly, 2014). Before surveying the schools, participants received a personal information document where we have explained that their names would remain confidential. The data collected is used exclusively for research purposes only and even if they are quoted, they will remain anonymous, and their identity is not revealed directly or indirectly. Once, participants decide to volunteer to be part of the research, they receive the consent letter in writing and they are left with sometime to come back to us with a signed agreement: the letter of correspondence includes the purpose of the study and the main objectives and the role of the participant in the study (Ketefian, 2015). A strict clause was declared and released to keep and protect the confidentiality of both students' and teachers' involvement through the UAE and they are free to withdraw anytime from the research. The collected data protected the participants' privacy and was not disclosed at any point or level of the study. The clause and terms and conditions in the British University of Dubai Study handbook states that the research would not be detrimental to the respondents in any way. There are two levels of contact maintained for the research: a letter was released from the University to perform the required surveys across the specified locations in the UAE. Approvals were obtained in writing from the

respective schools to conduct the survey smoothly. The BUID ethical protocol requires

confidentiality in the recruitment as well as in the interviewing.

Chapter 4: Results and Data Analysis

There is a presentation of the descriptive statistics between schools, teachers, and students in online teaching and online learning in the first hypothesis. While in the second hypothesis, one may note the correlation between the role of technology towards the training and the role of the teachers. In the third one, the relationship between technology towards the students and their performance is observed. In the fourth hypothesis, the relationship between technology and attitudes towards online teaching and online learning is shown. Similarly, one may note the relationships between Schools, Teachers and Students, Schools, Teachers, Students, and Online learning, Teachers, Training and Technology, Technology, Students and Performance, Technology, Students and Attitudes, Technology, Science Subjects and Attitudes, Perception, Technology and Students, Perception and Technology, Teacher, Science Subjects and Technology, Teachers, Students and Technology, Teachers, Technology, Performance and Students, Perception, Science Students and Attitudes and Students, Teachers, Training, Technology, and Students, Teachers, Online Teaching and Students, Online Teaching, Students and Online Learning, Teachers, Training, Technology, and Online Teaching, Technology, Online Teaching, students and Online Learning, Technology, Online Teaching, students, Online Learning and performance, Science Subject, Online Teaching, Students, Online learning and Attitudes and Schools, Teachers, Online Teaching, Students and Online Learning.

Several methods have been used in this chapter to analyze the data obtained. Instead of the SPSS, the current study was analyzed using two key software programs, R Studios, and WEKA that were used for the analysis. WEKA was primarily used for data mining operations to identify the key challenges of the online instruction. R Studios were used for data analysis to verify descriptive statistics, frequency and cross-tabulation, correlations, regression, multiple regression, and exploratory factor analysis. The separate headings of the chapter discuss more information. The scripts and related analytical codes are included in the research study's Appendices. In this chapter, the Descriptive Statistics, the assessment of the Research Model, and whether the established model is good or not have been emphasized. Test the hypothesis by different methods, such as t-testing, etc.

Data Cleaning

It was observed in the data that there were some duplicates keyed for the items like "Pref online platforms," "Challenges and Difficulties," "The best way to learn," "Benefits online learning," and "Disadvantages." In the raw datafile, it was also observed that the columns of "Start Time" and "Completion Time" comprised of both the dates and time. This was cleaned out, and separate columns were made for the date, start time, and completion time.

Few structural errors were fixed out at the time of the data cleaning. Since there were two languages used for the data collection, it was observed that some cells had only statements either in English or Arabic Language or both. This was sorted out to keep the smooth flow of the statements' interpretation and identify correct codes for each of the statements. In some cases, Google translation pages were also used for accurate translation and interpretation. In the raw data, the outliers were identified. The emergence of outliers can only be found with the statements of the "benefits of online learning" and "disadvantages." The problem was not present or found in the rest of the data set that was obtained for the study. There were rows where the respondents missed out on the data or the attention was not given to check out for the same at the time of the data collection. Thus, as per the research norms, the missing data was corrected and replaced according to the appropriate rules and regulations. Various techniques were given for handling the missing data like list wise or case deletion, pairwise deletion, mean substitution, regression imputation, last observation carried forward, maximum likelihood, expectation-maximization, and multiple hints (H., 2013). Data validation comes in a variety of forms. The validation rules for consistency are one of the most critical conditions. These rules apply to data types, ranges, uniqueness, consistent expressions, and null values must be avoided. Second, serious adherence to format requirements is essential. Validation by scripts, programs, and other methods are used to perform data validation. Tools such as FME and WEKA aid in preserving datasets and their use in the correct format. There are a variety of other methods for keeping track of the data set's validation rules. Source systems loop back verification, ongoing source to source verification, data issue monitoring, data certification, statistics collection, and process management are some of the techniques they employ.

4.2. Data Mining

4.2.1. Univariate Analysis

First, it may be observed that it is better to study each of the variables identified for the study. The data was present in the format of the CSV file. The WEKA software was used for the understanding of the same. Since the data file must be imported into the software, it must be converted to AIFF format, and this was done through WEKA itself. After the file was imported into the software, each variable was observed, and their quantified details were observed and noted in the tabular formats. It was also observed that the selected attributes were accustomed to their names, distinctiveness, types, whether it was a nominal or ordinal or ratio ones or not. It was also noted that the software itself calculated the count and weights of each variable. The details are given through the different images in the Appendices, i.e., at the end of the research study [See the Section on Raw Data (before Cleaning)]. Apart from these, there are visualizations of the identified variables in bar graphs and histograms. Through these, one may note that the variances and distributions of the variables may be known and understood.

Moreover, these observations also help in knowing the future analysis of the data. For example, one may know whether the variables are highly correlated or not. Whether this will showcase some issues or problems at Exploratory Factor Analysis steps only or not, the different models and importance of the variables in its comparison of the models, etc.

Table 4.1 shows that there were more women than men among those who took part in the study. The number of women who have been counted is 142, while the number of men who have been calculated is 77. Women made up 64.84 percent of the population, while men only made up 35.15 percent. In Table, it can be shown that the number of Emiratis is higher than the number of non-Emiratis. The Emiratis have a percentage of 63.01 percent. In comparison to Sharjah and Ajman, it can be seen in Table that Dubai's schools were covered more. Further information regarding factors is given in following Table.

Table 4.1: Frequency Distribution

	Number	Percentage
Count and Percentage of Cities		
Dubai	190	86.75799
Sharjah	26	11.87215
Ajman	3	1.369863
Count and Percentage of Nationality		
Not Emirati	81	36.9863
Emirati	138	63.0137
Total	219	
Count and Percentage of Gender		
Men	77	35.15981735
Women	142	64.84018265
Total	219	
Number of Cycles		
Cycle 2	142	64.84018
n/a	2	0.913242
Cycle 3	23	10.50228
Total	167	
Number of ICT Products		
Tablet	128	58.44749
Laptop	67	30.59361
Desktop	5	2.283105
Smart Phone	15	6.849315
Other Devices	4	1.826484
Total	219	
Online Learning Is better		
SA(Strongly Agree)	62	28.31050228
A(Agree)	104	47.48858447
Neutral	37	16.89497717
D(Disagree)	8	3.652968037
SD(Strongly Disagree)	8	3.652968037
Total	219	

SA(Strongly Agree)	53	24.20091
A(Agree)	111	50.68493
Neutral	49	22.37443
D(Disagree)	4	1.826484
SD(Strongly Disagree)	2	0.913242
Total	219	
Technical Skill and fixing		
Agree	81	36.9863
Disagree	28	12.78539
SA	32	14.61187
N	72	32.87671
SD	6	2.739726
Total	219	
Gaining Critical and Creative Thinking Skills		
Agree	101	46.33027523
Disagree	18	8.256880734
SA	48	22.01834862
N	48	22.01834862
SD	3	1.376146789
Total	218	
Self-Confidence		
Agree	92	42.00913
Disagree	15	6.849315
SA	44	20.09132
N	64	29.22374
SD	4	1.826484
Total	219	
Effective Teaching		
Agree	46	22.22222
Disagree	50	24.15459
SA	16	7.729469
N	57	27.53623
SD	38	18.35749
Total	207	
Gap between student and teacher		

Agree	61	29.7561
Disagree	43	20.97561
SA	29	14.14634
N	62	30.2439
SD	10	4.878049
Total	205	
Online Learning Better		
Agree	24	11.00917
Disagree	63	28.89908
SA	23	10.55046
N	32	14.6789
SD	76	34.86239
Total	218	
Types of Learning		
Online Learning	45	20.54795
Face to face	153	69.86301
Preferences	19	8.675799
n/a	2	0.913242
Total	219	

4.2.2. Descriptive Statistics

Descriptive statistics are brief descriptive coefficients that summarize a given data set, which can be either a representation of the entire or a sample of a population. Descriptive statistics are broken down into measures of central tendency and measures of variability. Descriptive statistics of the variables are given as under in Table 4.2 and Table 4.3.

Table 4.2: Descriptive Statistics for Each variable

Label	Sum	Mean	Gmd	SD
Gender	142	0.65	0.46	0.478563
Nationality	81	0.37	0.47	0.483873
School Emirates	0.44	1.28	0.49	0.711786
Phase	0.68	2.34	0.45	0.475622
Class	0.91	1.29	1.14	1.038914
Learning product	0.77	2.89	1.43	1.424146
School ICT device	0.87	3.93	0.98	0.962538
School Provided ICT	0.94	3.30	1.47	1.316984
School Support Data bundles	0.94	2.95	1.27	1.136029
School Professional Support	0.88	3.62	0.96	0.903055
Access Use	0.84	3.95	0.82	0.788517
Technical Skills Expert	0.91	3.48	1.07	0.983015
Critical Creative Thinking Skills	0.88	3.80	0.98	0.92657
Increase Self Confidence	0.89	3.72	0.99	0.924805
Effective Learning	0.91	2.86	1.20	1.097562
Gap teacher and student	0.93	3.11	1.23	1.101676
Online Learning better	0.93	2.33	1.45	1.331803
Pref online platforms	219	0.00	59	0.478563
Challenges and difficulties	219	0.00	19	0.483873
Best way to learn	217	2.00	4	0.711786
Benefits online learning	209	10.00	151	0.475622
Disadvantages	219	0.00	145	1.038914

Table 4.3: Variance and Standard Deviation

Label	Variance	SD
Gender	0.23	0.48
Nationality	0.23	0.48
School Emirates	0.51	0.71
Phase	0.23	0.48
Class	1.08	1.04
Learning product	2.03	1.42
School ICT device	0.93	0.96
School Provided ICT	1.73	1.32

School Support Data bundles	1.29	1.14
School Professional Support	0.82	0.90
Access Use	0.62	0.79
Technical Skills Expert	0.97	0.98
Critical Creative Thinking Skills	0.86	0.93
Increase Self Confidence	0.86	0.92
Effective Learning	1.20	1.10
Gap teacher and student	1.21	1.10
Online Learning better	1.77	1.33

It was found out through the Pearson's Chi-Squared Test that the p-value is 2.2e-16, degrees of freedom is 3706, and Chi-Squared value is 5236.2. These results confirmed that correlations between the variables are significant ones (See the analysis of the Chi-Squared in the Appendix 10 also).

4.4. Exploratory Factor Analysis

Before conducting the exploratory factor analysis, it was mandatory to create the correlation matrix. The reliability check for this data was performed by the end of the results analysis. This helped in the identification of the correlations between the variables and to see if there will be a problem of multicollinearity amongst them or not. From the matrix, it is observed that gender has a negative correlation with nationality and a positive correlation with the school of Emirates. Concerning nationality, it has a negative correlation with both gender and schools. The schools of Emirates have a positive relationship with gender and a negative one with nationality. The phase and class have positive correlations with gender, nationality, and schools. There is a negative relationship between learning products and gender and schools. However, it has a positive relationship with nationality. The ICT Devices given from the side of the schools have a positive relationship between gender and nationality. However, negative relationship with the schools. There was a negative relationship between the schools providing the ICT devices and the gender, nationality, and schools. It was between the data bundles and the nationality and schools, though it was positive with the gender. The professional support provided by the school was positive with the gender; however, a negative relationship with the schools.

The relationship was negative in the gender and the access use of the devices, and it was similar to the schools also. However, it was positive with the nationality. The relationship between the technical skills experts and gender and nationality was positive. However, it was not so with the schools at all. The relationship between critical and creative thinking and gender and nationality seems to be positive. However, it was negative with the schools. There was a clear positive relationship between the increase in self-confidence and gender, nationality, and schools. The practical learning was negative with the gender and nationality. However, it was a positive one with the schools. The gaps between the teachers and students were negative between gender and the schools of Dubai, UAE. However, it was positive with the nationality. It was also observed that there was a negative relationship between better online learning and gender and nationality. However, it was positive with the schools (See Appendix). This statistics analysis show that gender, nationality, and schools do play an important role in the online teaching and learning.

It was found that the mean item complexity is 1.5, and the test of the hypothesis was meant for six factors only. The degrees of freedom for the null model is 153, and the objective function was 5.73. The degrees of freedom for the model is 60, and the objective function was 0.4. The root means square of the residuals (RMSR) is 0.03. The df corrected root mean square of the residuals is 0.04. It was also seen that Fit based upon off-diagonal values = 0.98. The measures of factor score adequacy were found in the following manner. That infers that there is a direct influence on the online learning environment and learning effectiveness and this might affect indirectly on the students' attainment.
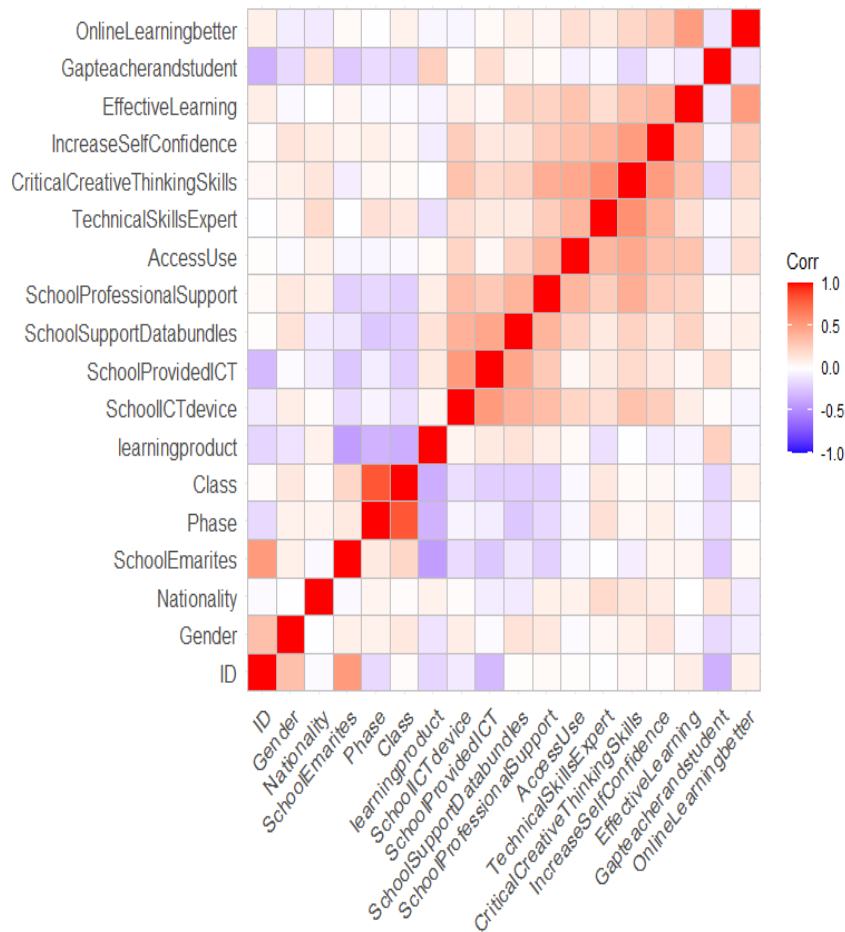
Figure 4.1: Corplot

The above Corplot shows the correlations between the different variables. The deep red color reveals that there is a strong relationship between the variables. On the other hand, the dark blue color shows a negative relationship and is below -1.0. Through this Matrix, one can see the perfect diagonal line in red color, which is the perfect one, and a one moves away from it, the relationship also reduces. Therefore, we can advise that there is no one cause behind the effectiveness of the online learning; it is important to have all factors available in order to have a positive experience for both students and teachers. The linear correlation shows that if one of these variables is not available of is not present at its outermost this will have an immediate effect on the implementation of the online learning.

After performing the Bartlett Test, it was found that the chi-square value is 527.9386. The significant probability value was 9.953378e-43, and the degrees of freedom is 153. The KMO

factor adequacy exhibited an overall MSA to be 0.69. The MSA values for each item was found to be different and for Gender- 0.51, Nationality- 0.57, School Emirates -0.61, Phase -0.55, Class- 0.59, learning product -0.75, School ICT device- 0.77, School Provided ICT -0.67, School Support Data bundles -0.76, School Professional Support -0.84, Access Use -0.83, Technical Skills Expert-0.77,Critical Creative Thinking Skills -0.79 -Increase Self Confidence -0.80, Effective Learning- 0.72,Gap teacher and student -0.69,Online Learning better - 0.60 . The root mean square of the residuals (RMSR) is 0.05. The df corrected root mean square of the residuals is 0.07. Fit based upon off-diagonal values = 0.94. The Measures of factor score adequacy was revealed certain values for the factors.

For MR1, the Correlation of (regression) scores with factors is 0.90, the Multiple R square of scores with factors is 0.82, and Minimum correlation of possible factor scores is 0.63. Similarly, for MR2, the Correlation of (regression) scores with factors was 0.97, the Multiple R square of scores with factors was 0.94, and the Minimum correlation of possible factor scores was 0.88. However, for MR3. The correlation of (regression) scores with factors is 0.91, the Multiple R square of scores with factors is 0.82, and the Minimum correlation of possible factor scores is 0.64. For MR4, the Correlation of (regression) scores with factors is 0.87, the Multiple R square of scores with factors is 0.76, and the Minimum correlation of possible factor scores was 0.52.

The correlation values for each of the variables were observed and are shown in below Table 4.3.

Table 4.3: Correlation Values

Nationality	**Gender**	**Online Learning better**
0.96740067	0.816058	0.798847
Gap teacher and student	**learning product**	**Effective Learning**
0.78551194	0.715292	0.663614
Access Use	**Technical Skills Expert**	**School Professional Support**
0.64599497	0.629912	0.605849
School Emirates	**Increase Self Confidence**	**School Support Data bundles**
0.60117694	0.583056	0.581798
School ICT device	**School Provided ICT**	**Critical Creative Thinking Skills**
0.50268728	0.476298	0.384468
Class	**ID**	**Phase**
0.29288718	0.245183	0.078878

From the above Table 4.3, it is observed that nationality has the highest correlation value and class has the lowest one. Which means that efficiency of the online learning is positively related to nationality, and then gender, and the learning product which is the science has a high effect as well on the online learning effect where we can see that the value is positive and 0.71. The Scree Plot showed the total number of factors to be extracted, and the same may be observed in the following plot:
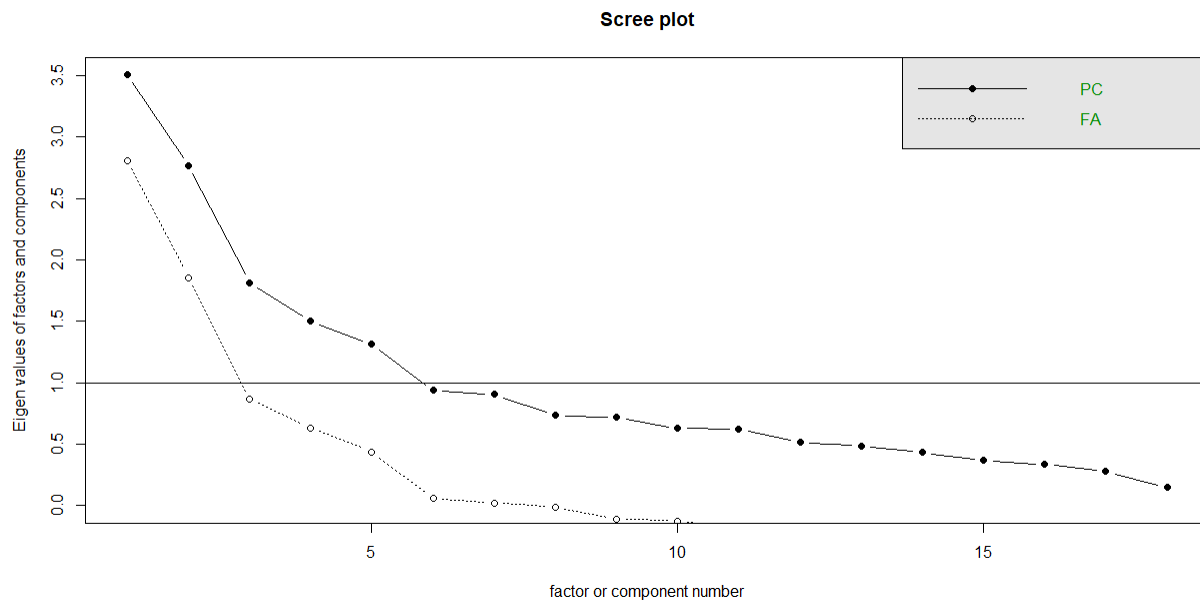
Scree plot

Plot 4.2: The Scree Plot to show how the gender influence positively on the online instruction

From Plot 1, one may state that four factors must be considered in the final analysis. However, one may even opt for 6. There are three rotations, viz. Oblivion, Varimax, and Promax. Finally, the varimax rotation helps to make the final decision concerning the total number of the factors listed above in the table 4.3. This was also analyzed through the parallel manner, and the plot 4.2 for the same may be seen in Plot 2.

Parallel Analysis Scree Plots
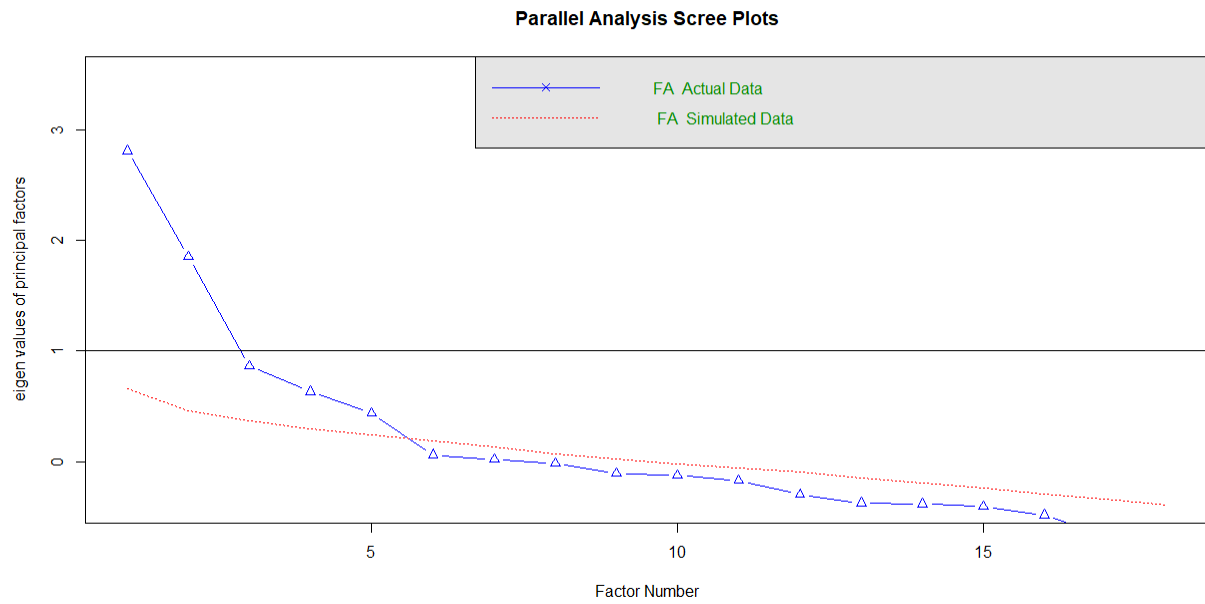
Plot 3: The Parallel Analysis Screen Plots

48
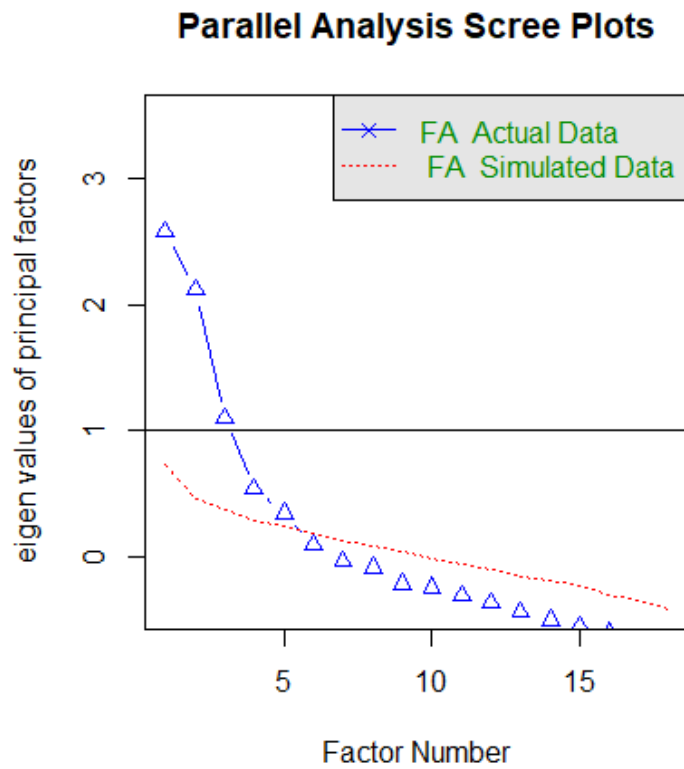
Plot 3.1
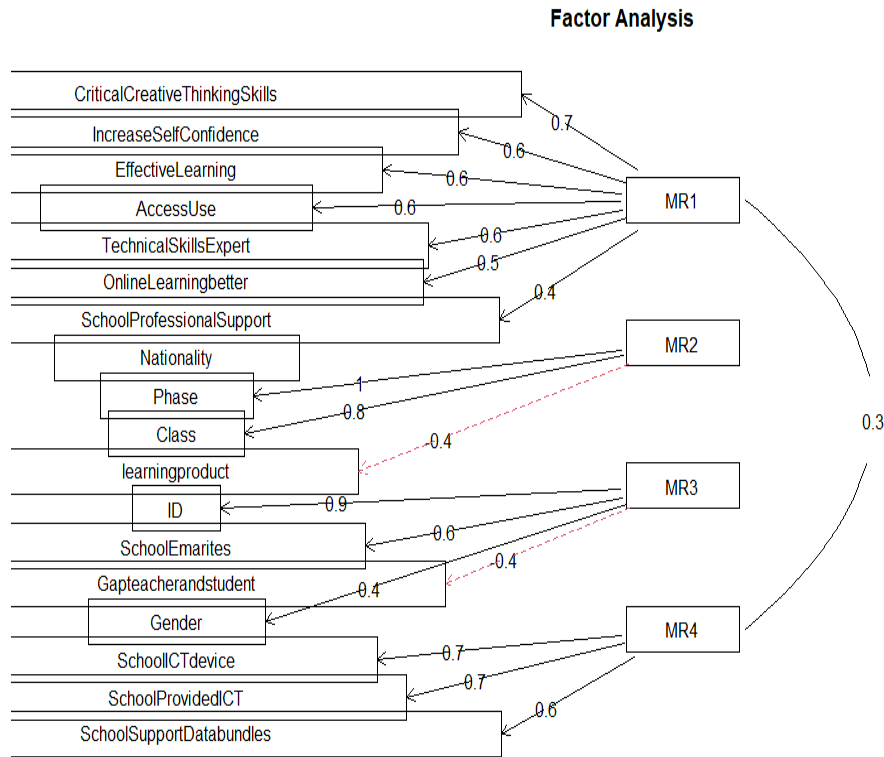
Figure 1: The Path Diagram of the Latent Factors

Finally, the Path Diagram for identifying and selecting the latent factors may be observed through Diagram 1. There are four latent factors viz. MR1, MR2, MR3, and MR4. The beta value of MR4 and MR1 is 0.3. That means that students and teachers' gender and nationality effect on the effectiveness of the online learning regardless of the grade level of the students and teachers for the same science discipline. On the other hand, the values between the latent factors MR1, MR2, MR3, and MR4 and the individual items may be observed in figure 1. One may also note the things that are grouped under each of the latent factors. Some of the values are low, and some are high ones. The ones with more than 0.6 are known for their high correlation, and those with shared values possess low correlation. These results show that the online learning is enhancing the students' critical thinking skills and teachers' technical skills; Moreover, Technical resources are of high importance and their presence is a determinant factor of the success of the online learning environment with a value of 0.7.

4.4.1. Importance of the Variables and Their Relationship towards the Model Building and Model fitness

It is through Multiple Regression; one may note the contribution of the variables in the model. The model was found to be fit with the presence of the variables gender, online learning better, and technical skills expert. The relationship between these three variables and effective learning was observed that the company of the gender was not significant as compared to the online understanding better and technical skills expert. Between these two also, the contribution of online learning better was more meaningful to the technical skills expert. It may be seen that the multiple r squared is 0.2713, adjusted R Squared is 0.2611, f-statistic is 26.68 with degrees of freedom as 215, and the p-value is 1.035e-14. More results may be observed in the Section representing the results of Multiple Regression in the Appendix. It is also worthwhile to note the fitness of the variables in the Model with the p-values. The presence of the access use of the ICT products and devices, data bundles, are given from the side of the school, online learning better, presence of the technical skills expert and increase in self-confidence was significant in the model building (See the Multiple Regression analysis in the Appendix).

Furthermore, the confidence intervals for the model parameters were 2.5% and 97.5%. The values for the variables are shown in Table 29. From the ANOVA table, the variables' rank is based on their high significance using the means: This data means that the school support, the access use of the products and devices had high significant probability values as compared to rest of the variables; that means that they positively influence both the critical and creative thinking skills, and students' self-confidence in the online learning context and affect its efficiency (diagnostic plots as given in the Appendix).

4.4.2. Comparison of the Models

It compares the models concerning the identified variables present in each of the fit model. In total, there are 12 fit models compared with each other. Their values were captured and compared for further analysis. The presence of the importance of the coefficients helped in the final decision of the models.

With the help of ANOVA, the models were compared, and the results are documented with the help of the f-tests and the probability values. It was found that Model 5, 6, 7, 9, 10, and 12 were

significant. However, 5, 7,9,10 and 12 proved to be more critical. In term of analysis, it was further cross-validated that effective learning has a value of 0.2510262. Which means that the effective online learning is directly related to gender, nationality, and school support and if well managed and provided students will be more engaged in the learning process. The factor analysis shows that if we cluster these variables, we might identify if there are some student groups that need special attention. The current research method did not measure aptitude, and achievement characteristics, but if in the future we cluster variables we might predict if online learning effect on assessment results. Under the variable selection through stepwise regression, it was found that gender had the value for AIC as 41.77. The gender and nationality had AIC as 43.631 and 43.767, and their together had a value of 43.63. Similar deals may be noted after the variables are added into the fitted model and observe the importance of the AIC. This helps in knowing the contribution of the variable in the model. It is also possible that a variable may not give any assistance and has not much role to play in the model. It also increases the value of the AIC. One may reconsider such variables. It is also and recommended to remove such variables from the model.

Apart from this, the values of the individual variables are checked out for the results. It may be possible that the values may improve after adding the rest of the variables, and one may add the left-out variable in the end. This ensures that the identified variable is not lost and plays its role in the model. More details may be seen under the Appendix and in the analysis of stepwise regression. It is well-known that the lower the value of the AIC, the better the contribution is seen through the added variable in the model. Therefore, it is always recommended to add variables one by one and check out the value of the AIC. Or fit the model with the variables one after another. In the meanwhile, one may note the importance of AIC in each of the model. It is good to see and report the results also.

Even in the multiple linear regression models, there are significant p-values. However, compared to the rest of the models, a variable may not contribute as much as possible, or the relationship between the Dependent variable and independent variables is effective. For each of the fit table models, one may observe that there are coefficient values against each variable. Secondly, there are estimate standards, errors, t-values, and probability values also (See the analysis of the Multiple Linear Regression in the Appendix for more details). There are also computations for

the model coefficients for each one of the variables. Some are negative ones and maybe comparable ones. Yet there are positive ones, and one may see them either increasing or decreasing order. For example, the model coefficients of gender, learning product, school ICT device, and the school provided ICT, technical skills expert, and gap teacher and student are negative ones. The rest of them possess positive coefficients. It is also observable that there are predicted values for each participant and share information about their role in the research study. The lowest value is 1.400715 for participant 62, and the highest is 4.646332 for participant 210. One may also place the ANOVA results for each variable about the rest of the variables and know their contribution. See also the Appendix for more information on the coefficients of the variables and intercept.

In each one of the models, one may also note that the values of the coefficients of the variables are changing as there is the addition of the variable. For example, in one of the models, the value of the coefficient of the gender is -0.26445, and for the same variable in another model, the coefficient value is -0.127592. Furthermore, the values are changing from one model to another one.

In comparing the models with the help of ANOVA, it is also observed that there is no f and probability value (greater than f) for the first model. It is recent from the second model onwards, and it may also change with the other models. Secondly, there may be probability values for the models; however, they may not be significant. For example, in the 4th model, the p-value is 0.35722286; however, it is not substantial. Nevertheless, for the 5th model, the p-value is 0.0005357, and it is a significant one too.

Under the Cross Validation analysis, the selected model was for the Dependent variable Effective Learning, and Independent Variables are Gender, technical Skills Expert, and Online Learning better. Coefficients are observed for each of the variables. With the help of bootstrapping, the prediction was made with the use of correlation, and it was found that the value for effective learning is 0.271314. Similarly, it was also found for the correlation results for the cross-validation of R Square and for effective learning, which is the dependent variable, the value was 0.2510262. To see the relationship between the variables and the model, the "Variable Selection" analysis was sound. It helped in identifying the role of the variable in the model. Secondly, there was a comparison done between the models with the help of the AIC

values. These values were collected, and observations were made. According to the prior literature, the lower the value of the AIC, the better the model is compared to the rest of the models.

CHAPTR FIVE: Discussion, Conclusion, Recommendations & Limitations

The current chapter presents discussion of main findings, conclusion, recommendations, and limitations of the study. The conclusions, we have reached throughout this study to answer the following questions 1) What are the UAE science teachers' & students' perception on their level of preparedness in the online science instructions in private schools? 2) What are the challenges that the science teachers and students encountered with online science instructions?

5.1 Discussion

The current study was carried out to investigate the science teachers' and cycle 2 and cycle 3 students' perceptions regarding the preparedness and implementation of the online science instructions during the COVID-19 pandemic in Dubai private education sector. From a population size of 500, 218 were taken as sample size for teachers and students. The study investigated the science teachers and students' perceptions with regards to possible challenges faced during the science online instruction. This is a unique study which hypothesis stressed on the science online instructions for students and teachers in the school context.

5.2. Science Teachers' and Students' Perceptions of Online Learning and Online Teaching

There present study has found interesting points to share and reflect on for future studies. The new model of the e-learning is worthy of the study as we have observed mainly the gaps between teachers and students' perceptions in the online environment. Teachers are less comfortable with the e-learning environment while students are. Thus, this gap must be eradicated by the lack of proper and appropriate relationship between teachers and students in the physical context therefore we have seen divergent perceptions as well when it comes to effectiveness of the online teaching and learning. Teachers were not seeing the efficient outcomes while students have seen more flexibility, more time management and are in favor of the online learning for science disciplines especially videos, simulations, and live experiments. These perceptions were different between boys and girls within the same grade level and throughout the academic levels as well.

Teachers of higher grades did not see the online learning as challenging as the higher education students are more independent learners and therefore, they did not have to change their pedagogical approaches or even change their styles; some technology information and techniques were added. Some teachers saw the new approach of the online learning made them rethink lesson plan, objectives, standards and learning outcomes. Teachers are more standard-based focused and skills- based focused and they now see the rationale behind a project-based learning pedagogy. Students see that there is no use into coming back to the long teaching days while they can finish all in a short time.

Students' answers in the questionnaire showed that they considered working in the online learning setting as fun and others minimal numbers as tiring and does not work for them. The study has shown as well that online learning effectiveness and quality depends as well of gender and nationality of both teachers and students. A study done by Ridge (2010) agree that the quality of the teaching is correlated with these two key factors Students still enjoy working in collaborative student-centered environments, even if it is virtual and have found ways to communicate using the google chats, the discords, the desktop WhatsApp. This might improve their communication skills however they are still within the virtual context. Students were satisfied with the overall context of staying home and enjoying the peaceful context of their home. Moreover, the result demonstrates student satisfaction with regards to the available resources found on the learning management system. The online learning has encouraged some students to express more their point of views and develop 21st century skills, such as critical thinking, problem solving, creativity, communication, and teamwork, and find easy to draw and tailor a resource and develop it and use it in the online context (Drake, 2012). To conclude, results has shown that the level of adaptability and motivation are age- dependent as some students in lower grade levels had more difficulties than older ones depending on their digital numeracy at the start (Drake, 2012).

5.3 Teachers and Students Challenges in the Science online learning context

The online learning is not a one size fits all; some students needed to be motivated more than others, and teachers who embarked this journey did not receive the proper professional development. The results of the current study correlate with the learning theories when it comes to social needs and the new online standards that were implemented within specific pandemic

times (Harasim, 2012). Our research results show that some of the teachers did not receive any professional development at all; whilst some did not even use the computer device earlier to the pandemic. In fact, the research has brought the learning theory of cognitivism to light and what could not be detected immediately as their challenges were in the inner workings mind (Harasim, 2012). Related to their inner anxiety and fear and sometimes lack of readiness. All of students agreed during the questionnaire that science needs more than only a virtual lab but an actual experimentation that might improve their achievement and increase their motivation. The research focus is the effectiveness of the learning in the online context. There is a positive correlation between the effectiveness of the learning and teachers' performance and teachers' competitiveness in the content itself as well as their mastery of the content. The current study has replicated the Constructivism theory that learning [in the online environment of the science subject] was shaped by individuals based on experience, thoughts, and interactions (Harasim, 2012).

Some challenges occurred because of the schools' leaderships that were not responsive and supportive either at resource levels or at communication level. Furthermore, findings have shown that parental involvement is an additional challenge that is engraved for students with special needs who need attention and care and handled by unexperienced fellows.

The learning management system is one additional barrier for some teachers and students who are still novice in the use and the navigation throughout which created academic delays for some and even dropouts for others. Above that results have shown a positive correlation between the effectiveness of learning and the choice of resources as well. All these listed examples are related to the professional development of the teachers. The professional development at this point of time was mandatory and building human capital capable to deal with challenges and innovate is becoming a requirement for teachers wishing to join the new recruitment pipeline. The time schedule of the session is an added challenge for both students and teachers but is an opportunity to think standard- focused teaching and learning and skills- focused teaching and learning. Students who do not grasp the basic concept in a 10 min timespan will not be able to follow the next, therefore teachers needed to re-design their perceptions about the whole philosophy of the teaching and learning journey. The well-being and the anxiety coupling the journey is a challenge that was reflected implicitly throughout verbs used in the participants answers such as tired, I do not like that make us rethink skeleton of the e-learning component and how to

implement it in a way that alternates between the needs and the academic requirements (Drake, 2012).

5.4. Conclusion

The research has a determined the basic component of the future e-learning method in science is the online learning context. The learners regarding of the challenges they have succeeded to have a good achievement and the online learning in its majority got the learners motivated. The UAE government has done a lot when it comes to emotional support for the context of the e-learning in all schools. The online learning ecosystem has created the need for both teachers and students to differentiate their strategies based on student skills, interests and has promoted new assessment matrix to assess learners differently based on the concept and the skills developed. In addition, the e-learning context has pushed more students into working collaboratively together not by choice which increased their writing and reading communication skills. Integrating new active teaching tools through Technological literacy showed changes in some students' behavior and performance. Results have shown divergent answers of students with regards to the information communication technology skills that led to a deeper and stronger understanding of the science concept for some and other struggled.

In the end, it may be concluded that the different hypotheses designed for the study were worth-while. These were understood with the help of the Correlations and Regression tests. The integrated model was explored both the prior literature and through the exploration of the factor analysis. With the descriptive studies, it was found that gender, nationality, and schools do play an important role in the online teaching and learning. Secondly, the relationship between the various variables were understood through the associative tests, correlation ship in the exploratory factor analysis, selection of the variables through regression, ANOVA and Chi Square Tests. There were variances, standard deviations, coefficients, and covariance which helped in understanding various relationships in both positive and negative manner.

However, it is through the Multiple Linear Regression that one really understands the role of the variables. This was done through the stepwise regression and helped to identify and formulize various models. These models were compared with one another. Furthermore, it was observed that the integrated model designed for the present study is good, fitted and highly significant one.

This is the contribution that has been achieved in the research. And if we wish even to go deeper in the discussion conclusions of the study resonates with Sue Prince (2019) that the online learning effectiveness might give us the content, the knowledge but as far as soft skills, the ones behind student's tenacity and perseverance they need the actual social communication.

5.5. Recommendations and Implications

The current study would recommend repeating the same data collection and work within a broader context that includes first all the UAE emirates private schools on one hand, and all UAE governmental schools as well. Governmental schools in the UAE have shown more preparedness when it comes to the switch to the e-learning ecosystem; first they received more training, second, they have been applying the smart school from 2012 with His Highness Sheikh Mohammad Bin Rashid Al Maktoum smart learning initiative. That means that the perceptions of teachers and students might be different and therefore the mean of the answers might change towards positive or negative perceptions. When it comes to the questionnaire, it might be of interest to add questions related to the auto-evaluation of the teachers themselves of their own performance. The online learning has brought a new definition of teaching depending on the future of the work. Gratton (2010) explains that the future for our [students'] work will be less about general skills and more about in-depth mastery; less about working as a competitive, isolated individual and more about working collaboratively in a joined world (p.25).

Since the present study is focused exclusively on the quantitative lines, it is also recommended that qualitative research might be of an added value and might get us to more rigorous results! Maybe, semi-structured or structured interviews conducted for the same and analyzed further and might be mapped with the existing questionnaire as well. The study can as well involve other samples such as parents and stakeholders who have their own perceptions about the e-learning context. Once this kind of study is conducted in several contexts as mentioned, in both Government Emirati schools and other areas for the private sector. Once the research study is done in different contexts, results will be more reliable, and we might define strategies and new policies related to the e-learning. Since technology is changing on daily basis, it will be worthwhile to understand the philosophies of changing the open and close sources of the technology in the education and how these resources might be used to suggest new pedagogies of teaching and learning for science subjects as well as other non-science subjects also. Finally, the

point that might as well interesting to look into is the security of the online-learning context when it comes not only to the academic usage but with regards to the habits of overusing technology in our day life and depending on his existence for answers, knowledge, ideas, discovery instead of creating what is new and adding to the existing.

Apart from this, teachers might be able to conduct some empirical research also. One may perform a Mixed Method Research and include qualitative research also. In this manner, there will be a combination of the samples from the actual and real fields of the investigation from the immediate communities. On other hand, the quantitative study will be helpful to capture a small sample size of the population and test it with the objectivity by generalizing it.

Such a study will certainly help in designing and rolling out of the public policies and help the policy makers to either redesign or design new polices in the educational sector for the improvement of the online teaching and learning in UAE. Furthermore, the study must be inclusive for other domains of education and subjects like commerce, finance, economics, humanities, medical sciences, engineering schools, etc. This will make the research more robust in nature. The population selected for the study make the study looks like it was tailored exclusively for Dubai. It is suggested to include more schools from different locations of UAE.

The results of the current study might support the stakeholders' new policies in building a new vision and mission to hybrid schools' model and might inspire curriculum specialists to develop an online curriculum based on skills and cognitive building more focused on students' academic achievement and skills development. Teachers and curriculum designers would need to go beyond simply applying the same learning theories and pedagogical techniques to current technologies and instead must use a new theory to revolutionize education in the 21st century using the online learning as a tool for the change (Carver, 2012).
Moreover, it about time to rethink professional development not only as a lecture or a workshop, but as a lifelong learning journey (McGowan, 2014) that will empower teachers considered always as the key factor for the success of the implementation of any reform the current study results guide the teachers to implement this approach frequently to improve their students' academic achievement.

5.6 Limitations

The current research study has tried to cover several areas and regions of the UAE however it was limited to only private schools in Dubai. This current study did not separate genders but included men and women, boys' and girls' in the study. Further the sample type and size does not allow a generalization but makes of this study a specific case of Dubai experience with regards to online learning experience. Thus, one may see that the integrated model presented in the study is well-knitted one and has implications for each one of the items and construct present in the path model. It gives a neat plan to see appropriate relationships between each one of them and how they associated and connected to reach out with the final aim or the goal. In other words, the designed path model is well-connected to the schools and the support received from the schools for the teachers and students.

Thus, there is a need to incorporate the qualitative research and publish the findings of their results. These may be compared or combined with the quantitative research. Thus, there will be new contributions in the conceptual and theoretical scenarios. In other words, the theoretical contributions will be introduced through the qualitative research and more ideas may be presented for the research. For example, there is no theory which discusses about the gap that has been created for the teachers and students in the online teaching environment. This must be theorized and included in the new theories of the education in the online mode.

Finally, since the questionnaire instrument is new as well as the topic itself in the UAE private schools, there was no need for the testing of the measurement and structural model for the time being. However, within the time it is more favorable to test the questionnaire and re check its validity if we wish to use on a bigger sample and in a wider scope of work. It was necessary to change the data that was collected from text to numeric format for analysis. Thus, the data was coded appropriately as per the standards and analyzed accordingly.

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Appendices

Table 1: Identification and Selection of the Variables

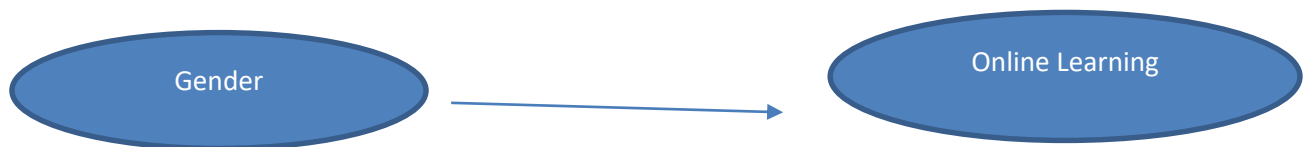| Independent Variables	Dependent Variables
Schools	Online Learning
Teachers	
Training	
Technology	
Science Subjects	
Perception	
Attitudes	
Performance	
Online Teaching	
Students	

List 1: Different Relationships observed in the prior studies

- Schools, Teachers, Students and Online learning
- Teachers, Training and Technology
- Technology, Students and Performance
- Technology, Students and Attitudes
- Technology, Science Subjects and Attitudes
- Perception, Technology and Students

- Teachers, Perception and Technology
- Teacher, Science Subjects and Technology
- Teachers, Students and Technology
- Teachers, Technology, Performance and Students
- Teachers, Perception, Science Students and Attitudes and Students
- Teachers, Training, Technology, and Students
- Teachers, Online Teaching and Students
- Teachers, Online Teaching, Students and Online Learning
- Teachers, Training, Technology and Online Teaching
- Technology, Online Teaching, students and Online Learning
- Technology, Online Teaching, students, Online Learning and performance
- Science Subject, Online Teaching, Students, Online learning and Attitudes
- Schools, Teachers, Online Teaching, Students and Online Learning

List 2: Relationships Between the Variables

1.Gender and Online Learning

2. Gender and Online Education In UAE

1. https://files.eric.ed.gov/fulltext/EJ1166619.pdf

2. https://www.researchgate.net/publication/228387203_Transformative_learning_UAE_women_and_higher_education

3. https://www.researchgate.net/publication/275603715_Teacher_Quality_Gender_and_Nationality_in_the_United_Arab_Emirates_A_Crisis_for_Boys

4. https://core.ac.uk/download/pdf/132799025.pdf

5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7366799/

6. https://educationaltechnologyjournal.springeropen.com/articles/10.1186/s41239-020-00194-2

7. https://www.mdpi.com/2071-1050/12/11/4465/pdf

8. http://www.open.ac.uk/research/sites/www.open.ac.uk.research/files/files/Documents/Online%20learning%20in%20tertiary%20education%20in%20the%20Middle%20East%20and%20North%20Africa%20.pdf

9. https://www.tandfonline.com/doi/full/10.1080/02671522.2019.1633557

3. Gender and Online Education
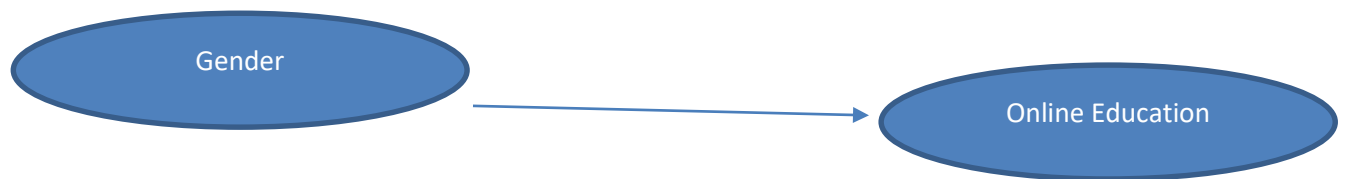
4. Level/ Stages of Education and Online Teaching
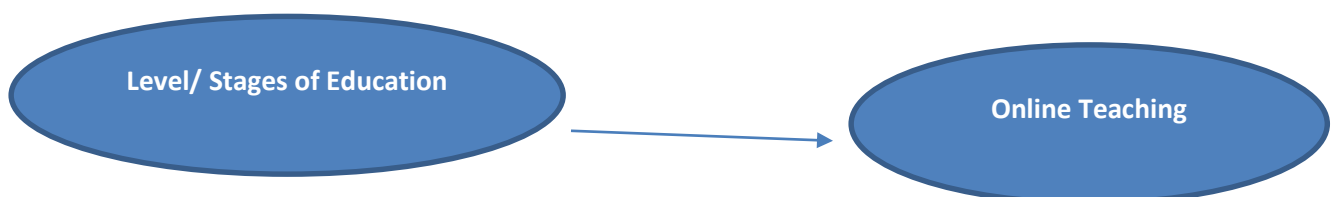
5. Experience and Online Teaching

Experience

Online Teaching

6. Subject Or Area Of Expertise And Online Teaching
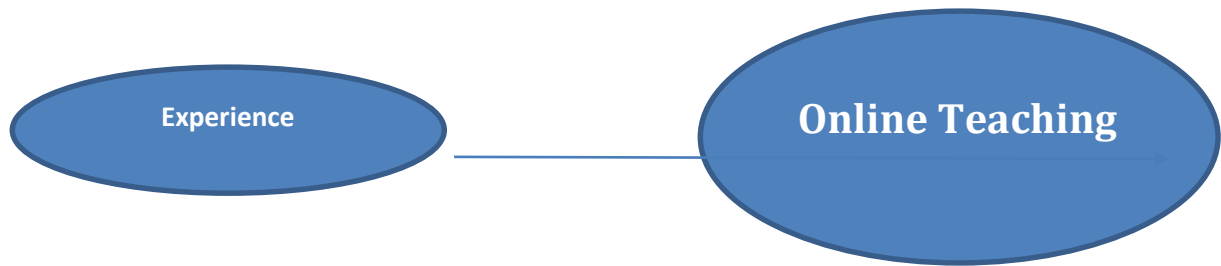
Subject

Online Teaching

7. Area of Expertise and Online Teaching

Area Of Expertise

Online Teaching

8.Subject Or Area Of Expertise Of Science And Online Teaching (Physics)

Science
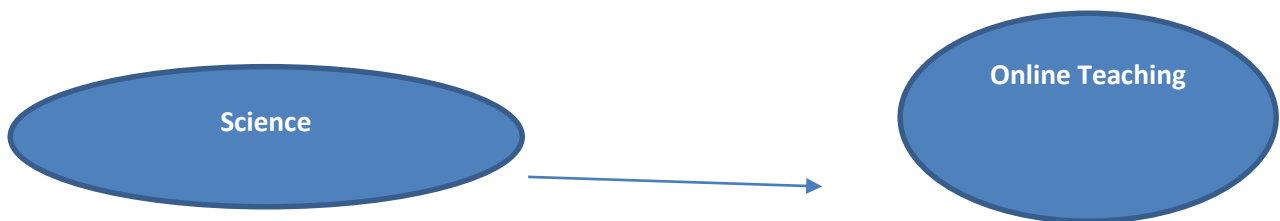
Online Teaching

9. Subject or Area Of Expertise Of Biology And Online Teaching

Biology → Online Teaching
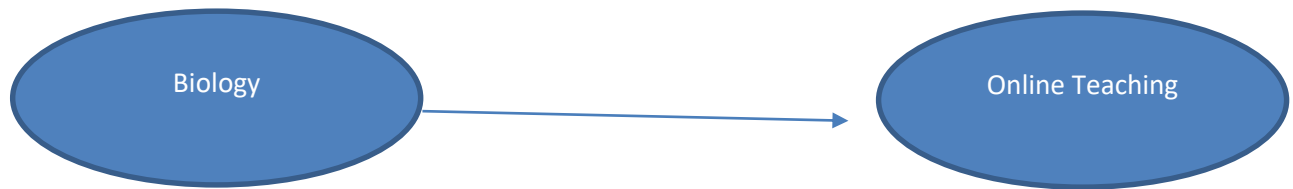
10. Subject Or Area Of Expertise Of Chemistry And Online Teaching

Chemistry → Online Teaching
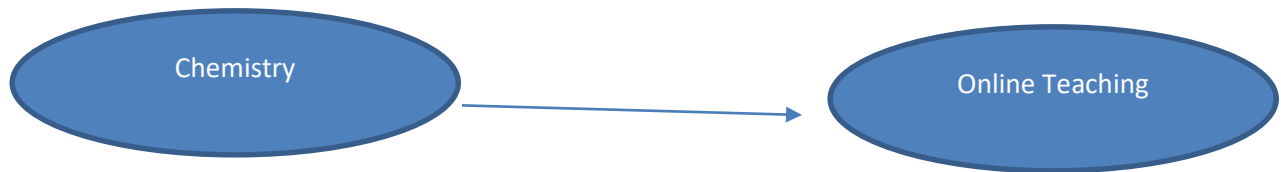
11. Subject Or Area Of Expertise Of Physics And Online Teaching

Physics → Online Teaching
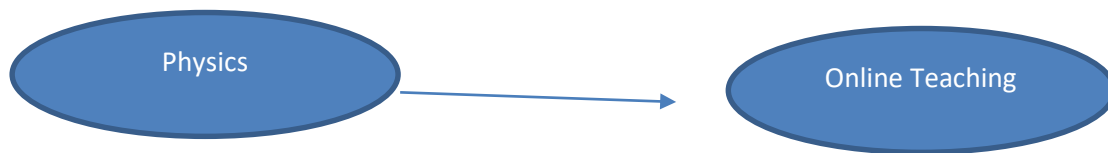
12. Workplace At Dubai And Online Teaching

Workplace → Online Teaching
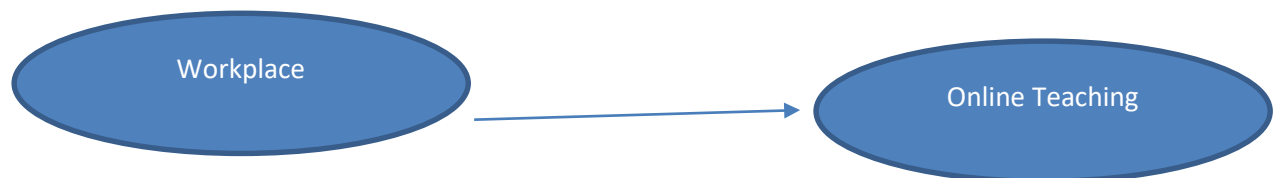
13. Workplace At Sharjah And Online Teaching

Sharjah → Online Teaching

84
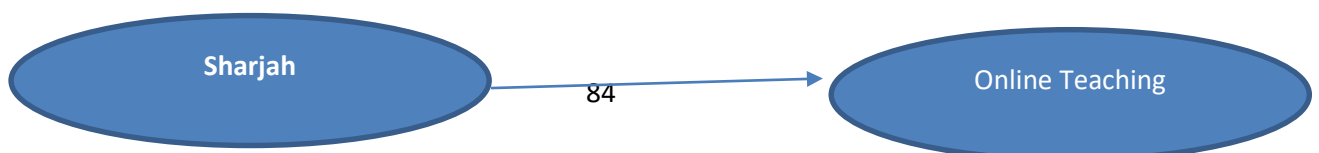
14. Workplace at Ajman And Online Teaching

Ajman → Online Teaching
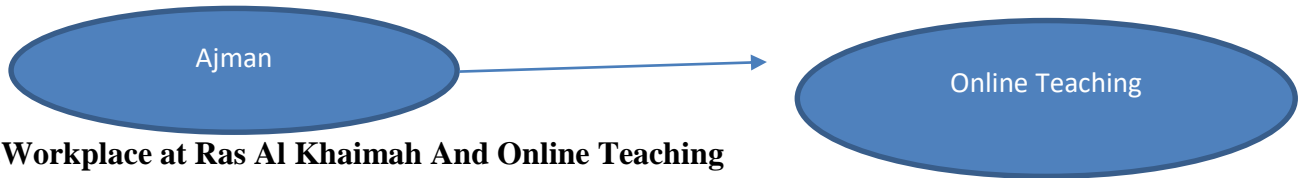
15. Workplace at Ras Al Khaimah And Online Teaching

Ras Al Khaimah → Online Teaching

16. Infrastructure and Science Virtual Classes

Infra-structure → Science Virtual classes
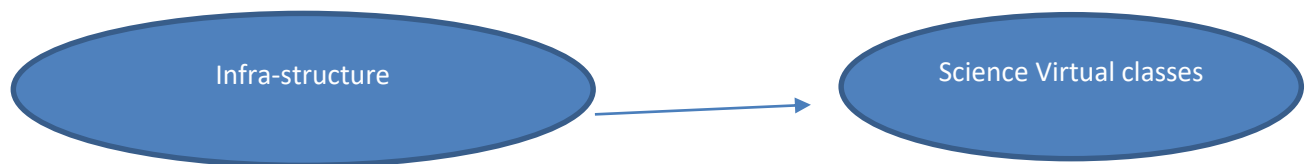
17. Training For Teachers And Online Platforms

Training — Online Platforms
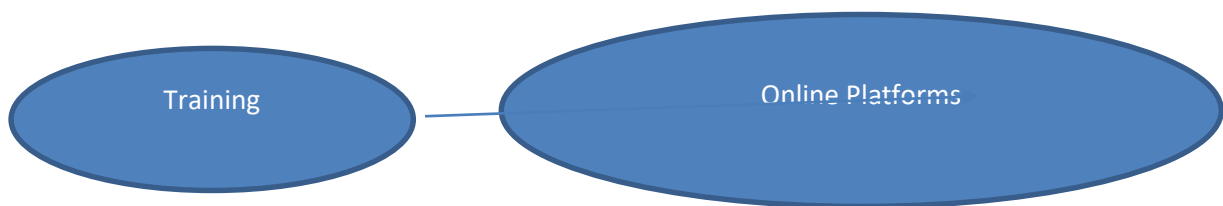
18. Training for Teachers And Virtual Labs

Training → Virtual labs

19. Training for Teachers And General Computer Applications

training → Computer applications
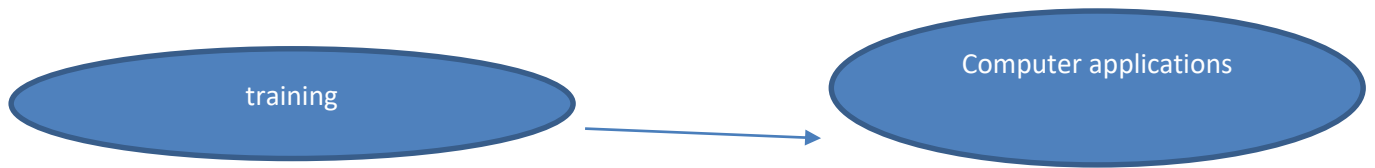
20. Online Platforms and Teachers' Presence

Online Platforms → Teachers Presence
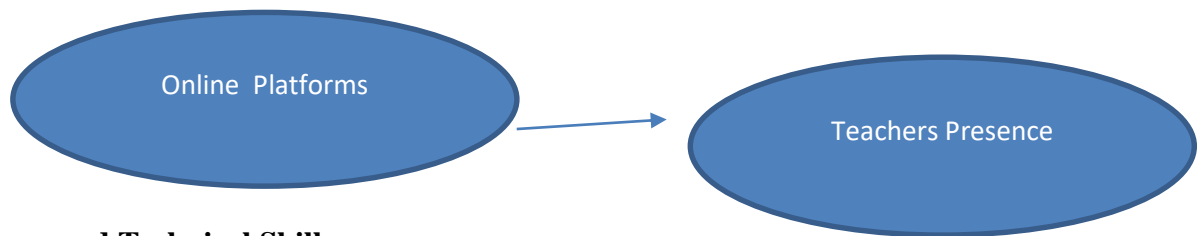
21. Teachers and Technical Skills

Teachers → Technical skills

22. Teachers, Technical Skills, and Implementations

Implementations

Teachers

Technical Skills
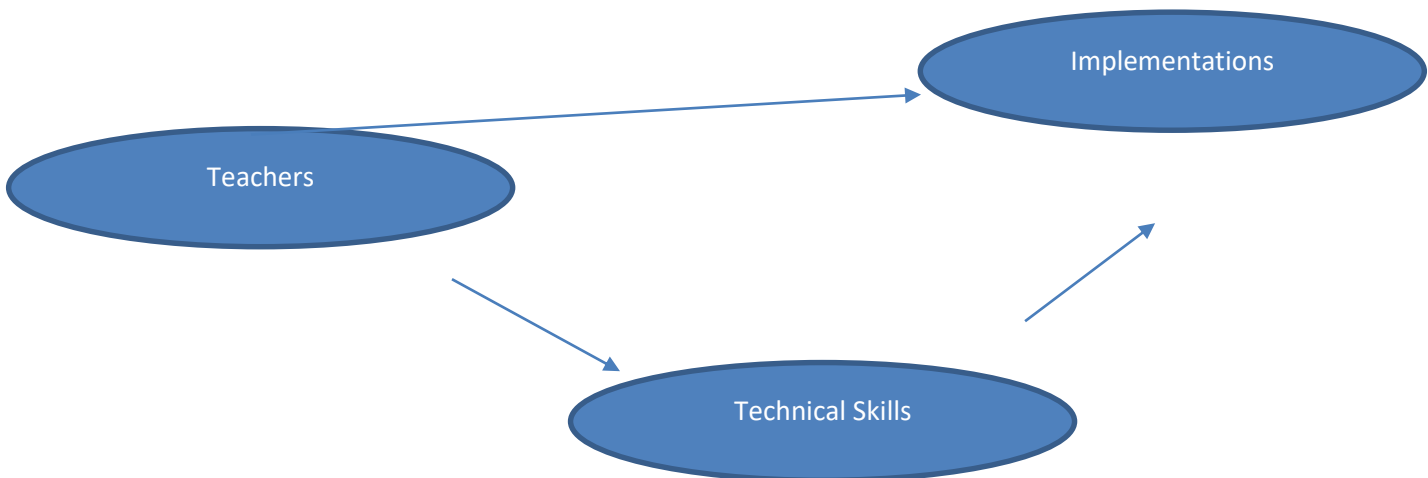
23.Effect of Online Learning and Variations In Pedagogical Skills

Effect of online learning → Variations in pedagogical skills
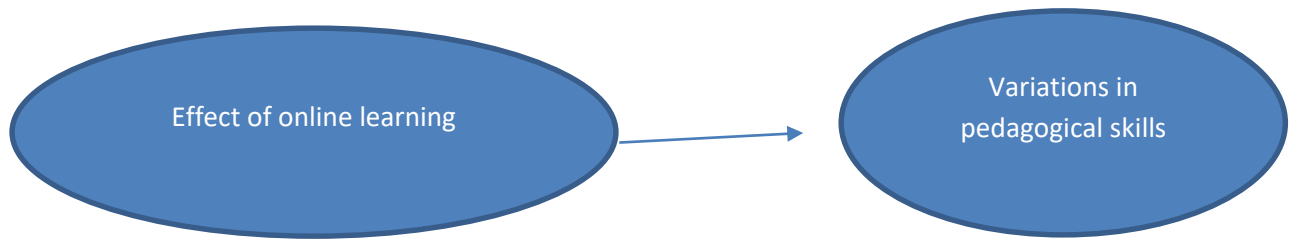
24.Full Delivery of Curriculum and Use Of Innovative Practices In Teaching

Full delivery of curriculum → Use of innovative practices
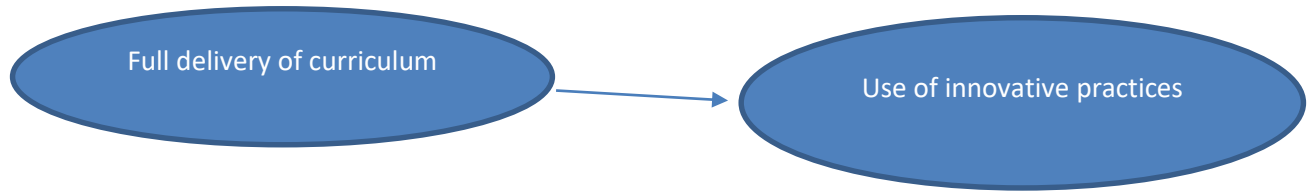
25.ICT Infrastructure and Teachers

ICT Infrastructure → Teachers
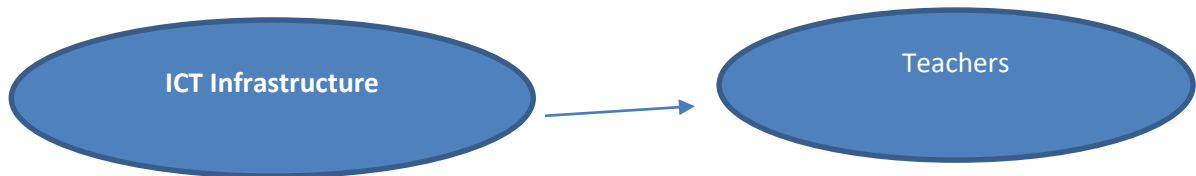
26.Lack Of Parental Support To The Learners And The School Impact The Effectiveness Of Online Learning

Lack of parental support → School impact on effectiveness of online learning
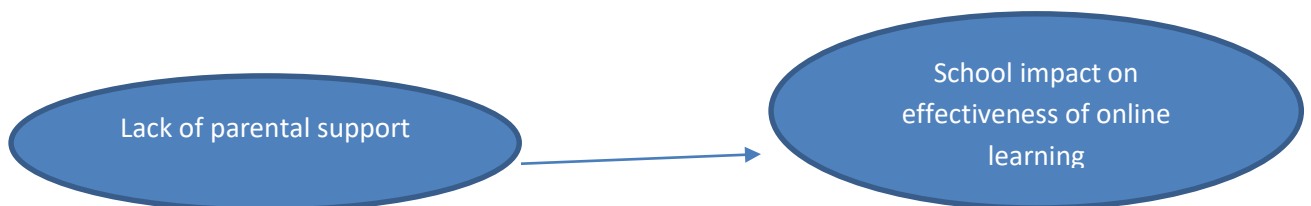
27.Obstacles In Online Learning

Obstacles → Online Learning
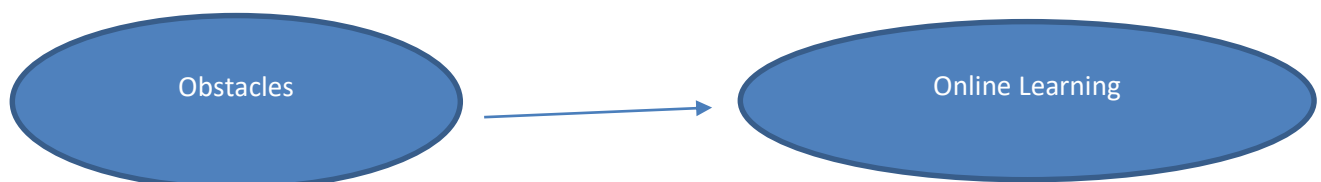
Table 15: Summary of the Descriptive Statistics

ID Gender Nationality	School Emarites Phase Class	learning product SchoolICTdevice SchoolProvidedICT	SchoolSupportDatabundles SchoolProfessionalSupport	AccessUse TechnicalSkillsExpert	CriticalCreativeThinkingSkills IncreaseSelfConfidence	EffectiveLearning Gapteacherandstudent	OnlineLearningbetter ter PrefonlineplatformS
Min. : 1.0 Min. :0.0000 Min. :0.0000	Min. :1.000 Min. :2.000 Min. :0.000	Min. :0.000 Min. :1.000 Min. :1.000	Min. :1.000 Min. :1.000	Min. :1.000 Min. :1.000	Min. :1.000 Min. :1.000	Min. :1.000 Min. :1.000	Min. :1.000 Length:219
1st Qu.: 55.5 1st Qu.:0.0000 1st Qu.:0.0000	1st Qu.:1.000 1st Qu.:2.000 1st Qu.:1.000	1st Qu.:1.000 1st Qu.:4.000 1st Qu.:2.000	1st Qu.:2.000 1st Qu.:3.000	1st Qu.:3.500 1st Qu.:3.000	1st Qu.:3.000 1st Qu.:3.000	1st Qu.:2.000 1st Qu.:2.000	1st Qu.:1.000 Class :character
Median an	Median n	Median :4.000 Median	Median :3.000	Median :4.000	Median :4.000	Median :3.000	Median :2.000

:110.0 Median :1.0000 Median :0.0000	:1.000 Median :2.000 Median :1.000	:4.000 Median :4.000	Median :4.000	Median :4.000	Median :4.000	Median :3.000	Mode :character
Mean :110.0 Mean :0.6484 Mean :0.3699	Mean :1.283 Mean :2.342 Mean :1.292	Mean :2.886 Mean :3.932 Mean :3.301	Mean :2.945 Mean :3.616	Mean :3.954 Mean :3.479	Mean :3.799 Mean :3.717	Mean :2.858 Mean :3.105	Mean :2.333
3rd Qu.:164.5 3rd Qu.:1.0000 3rd Qu.:1.0000	3rd Qu.:1.000 3rd Qu.:3.000 3rd Qu.:2.000	3rd Qu.:4.000 3rd Qu.:5.000 3rd Qu.:4.000	3rd Qu.:4.000 3rd Qu.:4.000	3rd Qu.:4.000 3rd Qu.:4.000	3rd Qu.:4.000 3rd Qu.:4.000	3rd Qu.:3.500 3rd Qu.:4.000	3rd Qu.:3.000
Max. :219.	Max. :4.000	Max. :4.000	Max. :5.000	Max. :5.000	Max. :5.000 Max. :5.000	Max. :5.000	Max. :5.000

0 Max. :1.0000 Max. :1.0000	Max. :3.000 Max. :3.000	Max. :5.000 Max. :5.000	Max. :5.000	Max. :5.000		Max. :5.000	

Table 16 : Overall Summary

ID Gender Nationality	SchoolE marites Phase Class	learnin gproduct SchoolI CTdevice	SchoolPr ovidedIC T SchoolSu pportDat abundles	SchoolP rofessio nalSupp ort Access Use	Tech nical Skills Expe rt	Critica lCreati veThi nking Skills	Increase SelfCon fidence Effectiv eLearnin g	Gapteac herandst udent OnlineL earningb etter
nbr.val 2.190000 e+02 219.0000 0000 219.0000 0000	nbr.val 219.0000 0000 219.0000 0000 219.0000 0000	nbr.val 219.00 00000 219.00 000000	nbr.val 219.0000 0000 219.0000 0000	nbr.val 219.000 0000 219.000 00000	nbr.v al 219.0 0000 000	nbr.va l 219.00 00000 0	nbr.val 219.000 00000 219.000 00000	nbr.val 219.000 00000 219.000 00000
nbr.null 0.000000 e+00 77.00000 000	nbr.null 0.000000 00 0.000000 00	nbr.nul l 5.00000 00	nbr.null 0.000000 00 0.000000 00	nbr.null 0.00000 00 0.00000 000	nbr.n ull 0.000 0000 0	nbr.nu ll 0.0000 0000	nbr.null 0.00000 000 0.00000 000	nbr.null 0.00000 000 0.00000 000

138.00000000	54.00000000	0.00000000						
nbr.na 0.000000e+00 0.00000000 0.00000000	nbr.na 0.00000000 0.00000000 0.00000000	nbr.na 0.00000000 0.00000000000	nbr.na 0.00000000 0.00000000	nbr.na 0.00000000 0.00000000	nbr.na 0.00000000	nbr.na 0.00000000	nbr.na 0.00000000 0.00000000	nbr.na 0.00000000 0.00000000
min 1.000000e+00 0.00000000 0.00000000	min 1.00000000 2.00000000 0.00000000	min 0.00000000 1.00000000	min 1.00000000 1.00000000	min 1.00000000 1.00000000	min 1.00000000	min 1.00000000	min 1.00000000 1.00000000	min 1.00000000 1.00000000
max 2.190000e+02 1.00000000 1.00000000	max 4.00000000 3.00000000 3.00000000	max 4.00000000 5.00000000	max 5.00000000 5.00000000	max 5.00000000 5.00000000	max 5.00000000	max 5.00000000	max 5.00000000 5.00000000	max 5.00000000 5.00000000
range 2.180000e+02 1.00000000 1.00000000	range 3.00000000 1.00000000 3.00000000	range 4.00000000 4.00000000	range 4.00000000 4.00000000	range 4.00000000 4.00000000	range 4.00000000	range 4.00000000	range 4.00000000 4.00000000	range 4.00000000 4.00000000

sum 2.409000e+04 142.0000000 81.00000000	sum 281.0000000 513.0000000 283.0000000	sum 632.000000 861.000000	sum 723.0000000 645.0000000	sum 792.0000000 866.00000000	sum 762.00000000	sum 832.00000000	sum 814.00000000 626.00000000	sum 680.00000000 511.00000000
median 1.100000e+02 1.00000000 0.00000000	median 1.00000000 2.00000000 1.00000000	median 4.0000000 4.0000000	median 4.00000000 3.00000000	median 4.0000000 4.0000000	median 4.00000000	median 4.00000000	median 4.00000000 3.00000000	median 3.00000000 2.00000000
mean 1.100000e+02 0.64840183 0.36986301	mean 1.28310502 2.34246575 1.29223744	mean 2.8858447 3.93150685	mean 3.3013986 2.94520548	mean 3.6164384 3.95433790	mean 3.47945205	mean 3.79908676	mean 3.71689498 2.85844749	mean 3.10502283 2.33333333
SE.mean 4.281744e+00 0.03233830 0.03269713	SE.mean 0.04809807 0.03213953 0.07020333	SE.mean 0.0962349 0.06504231	SE.mean 0.08899355 0.07676572	SE.mean 0.0610228 0.05328302	SE.mean 0.06642601	SE.mean 0.06261177	SE.mean 0.06249251 0.07416634	SE.mean 0.07444437 0.08999493
CI.mean.0.95 8.438914	CI.mean.0.95 0.094796	CI.mean.0.95 0.1896	CI.mean.0.95 0.175397	CI.mean.0.95 0.12027	CI.mean.0.95	CI.mean.0.95	CI.mean.0.95 0.12316	CI.mean.0.95 0.14672

e+00 0.06373573 73 0.06444297	75 0.06334398 0.13836414	699 0.12819224	89 0.15129799	02 0.10501581	0.1309194 0	0.12340189	684 0.14617486	283 0.17737152
var 4.015000e+03 0.22902266 0.23413347	var 0.50663986 0.22621591 1.07934314	var 2.0281932 0.92647983	var 1.73444766 1.29056177	var 0.8155084 0.62175862	var 0.9663189 6	var 0.85853127	var 0.85526371 1.20464162	var 1.21369025 1.77370031
std.dev 6.336403e+01 0.47856312 0.48387340	std.dev 0.71178638 0.47562160 1.03891440	std.dev 1.4241465 0.96253822	std.dev 1.31698430 1.13602895	std.dev 0.9030550 0.78851672	std.dev 0.98301524	std.dev 0.92656963	std.dev 0.92480469 1.09756167	std.dev 1.10167611 1.33180340
coef.var 5.760366e-01 0.73806566 1.30825030	coef.var 0.55473743 0.20304314 0.80396556	coef.var 0.4934938 0.24482680	coef.var 0.39892056 0.38572146	coef.var 0.2497084 0.19940550	coef.var 0.28252013	coef.var 0.24389273	coef.var 0.24881109 0.38397125	coef.var 0.35480451 0.57077289

Table 17: Descriptive Statistics for Each variable

S.No.	Label	n	missing	distinct	Info	Sum	Mean	Gmd
1	**Gender**	219	0	2	0.684	142	0.6484	0.458
2	**Nationality**	219	0	2	0.699	81	0.3699	0.4683
3	**SchoolEmarites**	219	0	4	0.443		1.283	0.4938
4	**Phase**	219	0	2	0.676		2.342	0.4524
5	**Class**	219	0	4	0.909		1.292	1.137
6	**learningproduct**	219	0	5	0.771		2.886	1.431
7	**SchoolICTdevice**	219	0	5	0.865		3.932	0.9831
8	**SchoolProvidedICT**	219	0	5	0.944		3.301	1.47
9	**SchoolSupportDatabundles**	219	0	5	0.938		2.945	1.267
10	**SchoolProfessionalSupport**	219	0	5	0.883		3.616	0.9627
11	**AccessUse**	219	0	5	0.844		3.954	0.8181
12	**TechnicalSkillsExpert**	219	0	5	0.909		3.479	1.069
13	**CriticalCreativeThinkingSkills**	219	0	5	0.88		3.799	0.9839
14	**IncreaseSelfConfidence**	219	0	5	0.892		3.717	0.9907
15	**EffectiveLearning**	219	0	5	0.908		2.858	1.198
16	**Gapteacherandstudent**	219	0	5	0.934		3.105	1.225

17	**OnlineLearningbetter**	219	0	5	0.928	2.333	1.446
18	**Prefonlineplatforms**	219	0	59			
19	**Challengesanddifficulties**	219	0	19			
20	**Bestwaytolearn**	217	2	4			
21	**Benefitsonlinelearning**	209	10	151			
22	**Disadvantages**	219	0	145			

Table 18: Variance and Standard Deviation

S.No.	Label	Variance	Standard Deviation
1	**Gender**	0.229023	0.478563
2	**Nationality**	0.234134	0.483873
3	**SchoolEmarites**	0.50664	0.711786
4	**Phase**	0.226216	0.475622
5	**Class**	1.079343	1.038914
6	**learningproduct**	2.028193	1.424146
7	**SchoolICTdevice**	0.92648	0.962538
8	**SchoolProvidedICT**	1.734448	1.316984
9	**SchoolSupportDatabundles**	1.290562	1.136029
10	**SchoolProfessionalSupport**	0.815508	0.903055
11	**AccessUse**	0.621759	0.788517
12	**TechnicalSkillsExpert**	0.966319	0.983015
13	**CriticalCreativeThinkingSkills**	0.858531	0.92657
14	**IncreaseSelfConfidence**	0.855264	0.924805
15	**EffectiveLearning**	1.204642	1.097562
16	**Gapteacherandstudent**	1.21369	1.101676
17	**OnlineLearningbetter**	1.7737	1.331803

Table 19: Overall Summary of the Variable

S.No.	Label	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
An Overall Summary of a Variable							
1	**Gender**	0.0000	0.0000	1.0000	0.6484	1.0000	1.0000
2	**Nationality**	0.0000	0.0000	0.0000	0.3699	1.0000	1.0000
3	**SchoolEmarites**	1.000	1.000	1.000	1.283	1.000	4.000
4	**Phase**	2.000	2.000	2.000	2.342	3.000	3.000
5	**Class**	0.000	1.000	1.000	1.292	2.000	3.000
6	**learningproduct**	0.000	1.000	4.000	2.886	4.000	4.000
7	**SchoolICTdevice**	1.000	4.000	4.000	3.932	5.000	5.000
8	**SchoolProvidedICT**	1.000	2.000	4.000	3.301	4.000	5.000
9	**SchoolSupportDatabundles**	1.000	2.000	3.000	2.945	4.000	5.000
10	**SchoolProfessionalSupport**	1.000	3.000	4.000	3.616	4.000	5.000
11	**AccessUse**	1.000	3.500	4.000	3.954	4.000	5.000
12	**TechnicalSkillsExpert**	1.000	3.000	4.000	3.479	4.000	5.000
13	**CriticalCreativeThinkingSkills**	1.000	3.000	4.000	3.799	4.000	5.000
14	**IncreaseSelfConfidence**	1.000	3.000	4.000	3.717	4.000	5.000
15	**EffectiveLearning**	1.000	2.000	3.000	2.858	3.500	5.000
16	**Gapteacherandstudent**	1.000	2.000	3.000	3.105	4.000	5.000
17	**OnlineLearningbetter**	1.000	1.000	2.000	2.333	3.000	5.000

Table 20: Covariance Details

Covariance		
Gender	-0.029859187	0.033192079
Nationality	0.071642645	0.171137518
SchoolEmarites	-0.040193233	0.009673322
Phase	-0.045026763	0.141957123
Class	-0.034604665	0.090369185
learningproduct	0.005672327	-0.091953324
SchoolICTdevice	0.236662110	0.139188495
SchoolProvidedICT	0.064776895	0.117442554
SchoolSupportDatabundles	0.202873564	0.094959700
SchoolProfessionalSupport	0.356060987	0.221346885
AccessUse	1.000000000	0.338814607
TechnicalSkillsExpert	0.338814607	1.000000000
CriticalCreativeThinkingSkills	0.433795393	0.503207604
IncreaseSelfConfidence	0.277292981	0.317993670
EffectiveLearning	0.249538076	0.104869409
Gapteacherandstudent	-0.033699798	-0.008562454
OnlineLearningbetter	0.134870450	0.082088833

It was found out through the Pearson's Chi Squared Test that the p-value is 2.2e-16, degrees of freedom is 3706 and Chi Squared value is 5236.2. These results confirmed that correlations between the variables are significant ones (See the analysis of the Chi Squared in the Appendix also).

Table 21: Correlation Matrix

	ID	Gender	Nationality	SchoolEmarites	Phase	Class
ID	1.00	0.33	-0.02	0.52	-0.16	0.02
Gender	0.33	1.00	-0.01	0.08	0.07	0.12
Nationality	-0.02	-0.01	1.00	-0.03	0.06	0.02
SchoolEmarites	0.52	0.08	-0.03	1.00	0.11	0.21
Phase	-0.16	0.07	0.06	0.11	1.00	0.82
Class	0.02	0.12	0.02	0.21	0.82	1.00
learningproduct	-0.18	-0.12	0.07	-0.42	-0.33	-0.35
SchoolICTdevice	-0.09	0.09	0.02	-0.15	-0.05	-0.14
SchoolProvidedICT	-0.30	-0.02	-0.08	-0.24	-0.08	-0.21
SchoolSupportDatabundles	0.01	0.15	-0.09	-0.11	-0.24	-0.21
SchoolProfessionalSupport	0.03	0.12	0.08	-0.20	-0.17	-0.21
AccessUse	0.01	-0.02	0.07	-0.04	-0.04	-0.03
TechnicalSkillsExpert	-0.01	0.04	0.19	-0.01	0.16	0.12
CriticalCreativeThinkingSkills	0.04	0.08	0.13	-0.07	0.04	0.03
IncreaseSelfConfidence	0.02	0.14	0.10	0.06	0.08	0.04
EffectiveLearning	0.09	-0.03	0.00	0.05	-0.03	-0.02
Gapteacherandstudent	-0.34	-0.16	0.14	-0.23	-0.15	-0.18
OnlineLearningbetter	0.08	-0.08	-0.09	0.03	-0.01	0.07

	learningproduct	SchoolICTdevice	SchoolProvidedICT
ID	-0.18	-0.09	-0.30
Gender	-0.12	0.09	-0.02
Nationality	0.07	0.02	-0.08
SchoolEmarites	-0.42	-0.15	-0.24

Phase	-0.33	-0.05	-0.08
Class	-0.35	-0.14	-0.21
learningproduct	1.00	0.06	0.11
SchoolICTdevice	0.06	1.00	0.52
SchoolProvidedICT	0.11	0.52	1.00
SchoolSupportDatabundles	0.15	0.40	0.46
SchoolProfessionalSupport	0.09	0.35	0.28
AccessUse	0.03	0.22	0.04
TechnicalSkillsExpert	-0.13	0.17	0.11
CriticalCreativeThinkingSkills	-0.01	0.32	0.19
IncreaseSelfConfidence	-0.08	0.26	0.12
EffectiveLearning	-0.05	0.09	0.04
Gapteacherandstudent	0.25	0.02	0.18
OnlineLearningbetter	-0.04	-0.04	0.03

Table 22:

	SchoolSupportDatabundles	SchoolProfessionalSupport
ID	0.01	0.03
Gender	0.15	0.12
Nationality	-0.09	0.08
SchoolEmarites	-0.11	-0.20
Phase	-0.24	-0.17
Class	-0.21	-0.21
learningproduct	0.15	0.09
SchoolICTdevice	0.40	0.35
SchoolProvidedICT	0.46	0.28
SchoolSupportDatabundles	1.00	0.39
SchoolProfessionalSupport	0.39	1.00
AccessUse	0.23	0.38

TechnicalSkillsExpert	0.11	0.26
CriticalCreativeThinkingSkills	0.23	0.42
IncreaseSelfConfidence	0.13	0.27
EffectiveLearning	0.23	0.23
Gapteacherandstudent	0.05	0.03
OnlineLearningbetter	0.08	0.05
AccessUse TechnicalSkillsExpert		
ID	0.01	-0.01
Gender	-0.02	0.04
Nationality	0.07	0.19
SchoolEmarites	-0.04	-0.01
Phase	-0.04	0.16
Class	-0.03	0.12
learningproduct	0.03	-0.13
SchoolICTdevice	0.22	0.17
SchoolProvidedICT	0.04	0.11
SchoolSupportDatabundles	0.23	0.11
SchoolProfessionalSupport	0.38	0.26
AccessUse	1.00	0.38
TechnicalSkillsExpert	0.38	1.00
CriticalCreativeThinkingSkills	0.45	0.57
IncreaseSelfConfidence	0.33	0.39
EffectiveLearning	0.31	0.18
Gapteacherandstudent	-0.06	-0.03
OnlineLearningbetter	0.17	0.11
CriticalCreativeThinkingSkills		
ID	0.04	
Gender	0.08	
Nationality	0.13	
SchoolEmarites	-0.07	

Phase	0.04	
Class	0.03	
learningproduct	-0.01	
SchoolICTdevice	0.32	
SchoolProvidedICT	0.19	
SchoolSupportDatabundles	0.23	
SchoolProfessionalSupport	0.42	
AccessUse	0.45	
TechnicalSkillsExpert	0.57	
CriticalCreativeThinkingSkills	1.00	
IncreaseSelfConfidence	0.51	
EffectiveLearning	0.33	
Gapteacherandstudent	-0.17	
OnlineLearningbetter	0.21	
	IncreaseSelfConfidence	EffectiveLearning
ID	0.02	0.09
Gender	0.14	-0.03
Nationality	0.10	0.00
SchoolEmarites	0.06	0.05
Phase	0.08	-0.03
Class	0.04	-0.02
learningproduct	-0.08	-0.05
SchoolICTdevice	0.26	0.09
SchoolProvidedICT	0.12	0.04
SchoolSupportDatabundles	0.13	0.23
SchoolProfessionalSupport	0.27	0.23
AccessUse	0.33	0.31
TechnicalSkillsExpert	0.39	0.18
CriticalCreativeThinkingSkills	0.51	0.33
IncreaseSelfConfidence	1.00	0.38

EffectiveLearning	0.38	1.00
Gapteacherandstudent	-0.05	-0.09
OnlineLearningbetter	0.28	0.51

	Gapteacherandstudent	OnlineLearningbetter
ID	-0.34	0.08
Gender	-0.16	-0.08
Nationality	0.14	-0.09
SchoolEmarites	-0.23	0.03
Phase	-0.15	-0.01
Class	-0.18	0.07
learningproduct	0.25	-0.04
SchoolICTdevice	0.02	-0.04
SchoolProvidedICT	0.18	0.03
SchoolSupportDatabundles	0.05	0.08
SchoolProfessionalSupport	0.03	0.05
AccessUse	-0.06	0.17
TechnicalSkillsExpert	-0.03	0.11
CriticalCreativeThinkingSkills	-0.17	0.21
IncreaseSelfConfidence	-0.05	0.28
EffectiveLearning	-0.09	0.51
Gapteacherandstudent	1.00	-0.11
OnlineLearningbetter	-0.11	1.00