A Phenomenological Study Exploring the Lived Experience of Science and Technology Students in Further Education Engaging with Online Learning during Covid-19

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Abstract

Covid-19 a worldwide pandemic has caused a global disruption to many activities, including educational activities. This pandemic has caused a crisis-response migration to emergency remote education necessitated by travel restrictions and social distancing measures implemented. This research explores the lived experience of four Science and Technology students in an Irish Further Education (FE) Institute engaging with online learning during Covid-19 and concludes on the impact of this on the learning experience and explores relevant literature pertaining this. As STEM subjects are practical by their nature, this study aims to uncover the lived experience of learning these subjects online. The focus of this research area developed from my personal interest as a student and my professional interest as a teacher of science.

This study details a phenomenological inquiry utilising the qualitative approach of semi-structured interviews to understand the subjective experience of each participant. Non-probability purposive sampling was used for participant selection to ensure the phenomenon was appropriately researched. The data collected was interpreted through thematic analysis, identifying three significant themes of: (1) Communication as an invaluable feature of online learning, (2) Skills sets in online learning and (3) Empowering learners through online learning. These emerging themes are not representative of anything outside of this specific context.

The findings of this study emphasise the opportunities online learning provides but also highlights the skills deficit in STEM subjects that was created. It is evident from this research, the need for teachers to be trained in the delivery of online teaching and learning. As online learning is part of the future trends in FE, this research has significant implications and provides the knowledge and understanding to improve online teaching and learning in this area and provide equal opportunities for all learners. This study concludes with recommendations for future practice and a statement of opportunities for further research.

Key words

Online Learning, Community of Inquiry Framework, Further Education, Science and Technology, STEM Education, Educational experience, Covid-19, Student Experience, Emergency Remote Learning, Distance Learning, Thematic Analysis, Phenomenology

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Abbreviations and Acronyms

BTEC	Business and Technology Education Council
C&G	City and Guilds
CL	Collaborative Learning
CoI	Community of Inquiry
ERE	Emergency Remote Education
ETB's	Education and Training Boards
FE	Further Education
FET	Further Education and Training
IBL	Inquiry Based Learning
ICT	Information Communication Technology
ITEC	International Therapy Examination Council
NCI	National College of Ireland
NFQ	National Framework of Qualifications
QQI	Quality Qualifications Ireland
S&T	Science and Technology
STEM	Science, Technology, Engineering and Mathematics
TA	Thematic Analysis
TEL	Technology Enhanced Learning
UDL	Universal Design for Learning

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Chapter 1: Introduction

1.1 Introduction

This chapter details what the research study is about, why the research area has been chosen and discusses what the research hopes to achieve. This is a research study situated within the context of learning and teaching in Further Education (FE), specifically online learning in Science and Technology (S&T) courses/Science, Technology, Engineering and Mathematics (STEM) subjects within FE. This research pertains to the lived experience of students partaking in online learning in S&T courses in an Irish FE Institute during Corona Virus also known as Covid-19, an unprecedented worldwide pandemic. The FE college in which this study is set hosts approximately 1100 students each year across various disciplines. For the purposes of this research, S&T courses offered at Level 5 & 6 on the National Framework of Qualifications (NFQ) from within the Science, Computing and Engineering Department at this host FE Institute were the focus of the study. These courses consist of a range of different modules including STEM subjects. As STEM subjects are practical by their nature, this study uncovered the lived experience of learning these subjects online. As online learning is a new concept in FE, there is little research like this that exists in a single study, while there is also little existing research relating to the sudden migration to online learning due to external factors such as Covid-19.

1.2 Background and Rationale

Further Education offers a range of educational initiatives to promote lifelong learning and inclusivity in education. In an ever-changing digital world where technology is continuously advancing the concept of online/blended learning has not yet been fully adopted in FE institutions. However the Covid-19 pandemic, has fast-tracked changes to how education is delivered worldwide necessitated by social distancing measures preventing face-to-face teaching (Longhurst et al., 2020). Covid-19 has led to a change in teaching and learning, in March 2020 all schools and colleges in Ireland were closed with all teaching and learning in Further Education moving online. Quality and Qualifications Ireland (QQI) who are responsible for promoting quality and accountability in

education and training services in Ireland gave a directive to provide provision for online learning where possible, due to this, online and blended learning are newly adopted concepts in FE. Moving teaching and learning online was a sudden migration to emergency remote education (ERE). In September 2020, schools and colleges opened for a new term however, due to the ongoing pandemic and the travel/movement restrictions implemented by the Irish Government, most of the learning in FE remained online except for some practical classes taking place in colleges when permissible. Because of this, it is now more crucial than before to ensure learning is reformed, as the way in which we work, learn and engage with one another is changing due to advanced technology and education providers need to keep up with this change and embed technology in the delivery of teaching and learning or risk becoming irrelevant (SOLAS, 2020).

Over the last number of years, Information Communication Technology (ICT) has changed the way in which education is delivered, enhanced teaching and learning motivation, allowed for a more flexible education, and helped learners to create in depth understandings of their subjects (Saravanakumar, 2018). ICT continues to grow and will continue to enhance the quality of education worldwide. However, the role of ICT in education is one that needs to be implemented rigorously to ensure an optimum teaching and learning environment is created for both teachers and students. For teachers and students, ICT can be viewed as an enhancement or a barrier to teaching and learning. ICT can play a vital role in scaffolding learning and its proper usage can empower both learners and teachers. While the role of ICT in education is increasing, the sudden outbreak of Covid-19 rapidly brought about a change to teaching and learning that was not anticipated. This change to teaching and learning occurred so suddenly, not all colleges, teachers and students were prepared for it, thus the need for understanding the experience of this grows.

As previously stated, S&T courses and STEM subjects are practical by nature and require that students learn specific associated skills. There are a wide variety of teaching methods for such subjects, however typically, most of the module content is conducted in a laboratory actively

conducting practical skills and experiments. This leaves the question of how or if these learning activities can be replicated in an online learning environment. A recent study conducted by Evagorou & Nisiforou, (2020) highlights the urgent need to prepare HE educators for the following: (1) how to teach online, and (2) to explore the specific pedagogical practices that might be important in each field (i.e. using virtual experimentation in science) and include them in teacher preparation courses. This is important and applies also to a FE context, it is imperative that teachers be trained in the delivery of ERE, online learning and the use of different digital platforms to ensure enhanced learning across a multitude of disciplines.

There are few published studies outlining student's perception of online or blended learning during COVID-19 and exploring how this has impacted teaching and learning environments worldwide however, there are many arguments associated with online learning (Dhawan, S. 2020). QQI, (2020) conducted a study to determine the effect of online learning during Covid-19 and the sudden change to ERE. This study found that learners enjoyed the flexibility associated with online learning but missed the face-to-face interaction of a classroom environment.

A study conducted by McGuiness et al., (2014) outlines that it is the first study of its kind to map FET provision in Ireland. Some studies conducted since then in FE have related to the experience of mature students (Hardiman, 2011), the student experience of work placement (Hawkins, 2017) and predicting academic performance (Quinn and Gray, 2020). While there are existing studies pertaining to the student experience of online learning during Covid-19 in Higher Education in Ireland (Yang, 2021), there is little available literature on emergency remote learning in a FE context particularly within S&T subjects. The previously mentioned QQI, (2020) study does not conduct research in any one subject area which led me to perceive a gap in literature pertaining to the student experience of online learning in S&T subjects within FE. QQI, (2020) also stated that their research conducted on ERE may not be sustainable as teaching and learning continues throughout the Covid-19 pandemic.

Literature reviewed throughout this research pertains to teaching and learning within S&T courses in FE, identifying how adults learn, teaching practices during Covid-19, and how an educational experience is developed focusing on the Community of Inquiry (CoI) framework to establish this. The CoI framework (Garrison et al., 2000) provided a foundation for this investigative research as it measures an online meaningful collaborative educational experience through exploring three interdependent elements of social, teaching and cognitive presence. As this context is so new, there are studies continuously emerging on the impact of ERE throughout a global pandemic however, this research aimed to understand the impact of ERE in the specific context of online learning in S&T courses in FE in a single study.

This study captured the phenomenon of a range of diverse students lived experience of online learning in such practical subjects. As this mode of learning is relatively new to FE, through this research the impact of online/blended learning on the overall student learning experience was investigated to help determine the effectiveness of online learning in these subjects for the future. This research identified the theories of teaching and learning that underpin online learning with particular attention to its application in science and technology subjects. The chapters within this dissertation take the researcher and the reader on a journey to understanding the lived experience of participants and the theoretical perspectives of this.

1.3 Researcher Positionality

As a science teacher in FE, this impacts me, I am also currently a student completing a MA in Educational Practice through online learning. Being part of this change to teaching and learning has prompted me to understand the lived student experience of engaging with online learning in S&T courses with a view to improving pedagogical excellence in this area as I know from experience that tailoring teaching and learning methods to suit each individual learner is not an easy task. One of my core values as a teacher is to ensure that all learners have access to equal learning opportunities. In an online learning environment, there is more responsibility on students to take ownership of their

own learning and become self-directed in their learning. To understand the student experience of online learning would afford myself and teachers within the FE community, the opportunity to tailor online teaching and learning methods to appeal to each individual learner and enhance the overall learning experience. It is imperative to understand the student experience of online learning to determine the implications of this and provide guidance for future planning related to flexible learning. Being in this position gives me an insight into this area while also making me an insider researcher, the implications of which will be discussed later in the methodology chapter.

1.4 Aims and Objectives

The impact of COVID-19 has led to a change in conventional teaching and learning methods. This research explores how this change of teaching methods has impacted learning, in teaching modules online, the content remains the same, but the delivery has changed and the approach to teaching and learning for both teachers and students has had to be adapted. To understand individual students experience of online learning in S&T courses/STEM subjects in FE will afford teachers the opportunity to improve teaching and learning in this area and to ensure all learners are provided with equal learning opportunities through this teaching and learning method.

This research uncovers the impact of online learning on the student learning experience and draws a conclusion on how online teaching and learning can be tailored to meet the learning needs of all individual learners to ensure equal opportunities for every student. The outcomes of this research are similar to that uncovered in the previously mentioned QQI report, that there are positive experiences of online learning but that there are also negative experiences related to the barriers and challenges of online learning. All findings were treated with the same rigour and allow the opportunity for further research in this area. The findings of this research are from multiple perspectives and all opinions and attitudes of participants were valued.

This research is a phenomenological qualitative inquiry conducted through an interpretative paradigm to construct a human science account of a persons lived experience using semi-structured

interviews as the data collection method to allow participants to speak freely and tell their own story about their experience of a phenomena (Sloan & Bowe, 2014). The data collected from these interviews was thematically analysed (Braun & Clarke, 2012). The findings of this study are subjective to individual participants and are not statistically representative. As online learning is a recent concept in FE and will form part of future trends in education, the findings of this study contribute to a wider discussion and new research in this area.

1.5 Dissertation Structure

The structure of this dissertation research study is logical and aims to systematically uncover information related to the phenomenon at question. The research begins with a Literature Review chapter that provides a background to FE, explores literature and theoretical perspectives related to teaching and learning of STEM subjects in an online learning environment during Covid 19 and the foundations of an educational experience. This review aided in the development of specific research questions. After establishing the research questions based on the literature explore, comes the Methodology chapter. The Methodology chapter discusses the chosen research design and the rationale for this, outlining the most appropriate research method to answer the research questions consisting of the data collection and data analysis process. The Methodology chapter also outlines the ethical implications of this study, insider research, the steps taken to maintain quality and rigour throughout the research process and the limitations of this study. The next chapter is the Findings and Discussions chapter which presents and explores the data that arose from the data analysis process, discussing and arguing this in detail. The research study ends with a Conclusion chapter to detail the overall research process, the implications of this study, the recommendations for future research and a personal reflection on the research process. Each chapter throughout this dissertation entails a brief introduction to outline its purpose, a body of text and a summary to conclude on its contribution to the study.

1.6 Summary of Chapter

This chapter has introduced the dissertation research study, outlining a systematic approach to gaining information and seeking a better understanding of the lived experience of students of S&T courses in FE engaging with online learning during a worldwide pandemic and how this has impacted the learning experience. This study concludes on the benefits and barriers to online learning with a view to creating awareness of this for teachers and improving pedagogical excellence in this area and creating an optimum online learning environment for learners to reach their individual learning potential.

Chapter 2: Literature Review

2.1 Introduction

The different stages involved in producing a literature review are equivalent to the stages involved in conducting primary research; problem formulation, data collection, data evaluation, analysis and interpretation and public presentation (Randolph, 2009). This literature review will focus on providing information on the key themes pertaining to the research objective of understanding the student experience of online learning in Science and Technology courses in Further Education. Relevant literature will be explored and my own thoughts on this research topic will also be provided throughout.

This review will be structured into themes relevant to the research topic to understand a holistic view of the research area, firstly I will provide a background to the Further Education and Training (FET) sector within Ireland and the area of S&T in education. I will then provide information on the foundations of learning and review concepts in relation to adult learning, online learning, the teaching practices that have emerged due to COVID-19 and the aspects of educational experience. This review will conclude with a defined research question(s) based on the uncovered literature.

This is a narrative review; all literature was gathered over a period of 3-6 months from reliable research databases and online libraries. The key search words to gather this literature included: online learning, distance learning, blended learning, hybrid learning, ERE, S&T, STEM, and student experience. The literature found was analysed thematically, the themes throughout this literature review move from general to specific to aid in the development of an appropriate research question(s). This research is conducted through an interpretative paradigm to understand the research area of the student experience of online learning.

2.2 Further Education and Training in Ireland

The term FE was first recognised in the White Paper on Education document from the Department of Education and Science (DES) proposing a FE Authority (DES, 1995) to govern life-long

learning, the future of adult education. The function of FE was to "provide a coherent national developmental framework" (DES, 1995, p.81) and "to have responsibility for the coordination of adult education, apprenticeships and Post Leaving Certificate education" (Hardiman, 2012, p. 7). FE has developed overtime and has now become FET.

FET in Ireland is governed by Education Training Board's (ETB's) which were established on 1st July 2013 when The FET Act 2013 was signed into law, which saw the amalgamation of 33 Vocational Education Centres and FÁS training centres. There are 16 ETBs across Ireland providing a range of education and training courses to their local communities. SOLAS, the Further Education and Training Authority was established on 27 October 2013, following the commencement of the FET Act 2013. SOLAS currently operates under the Department of Further and Higher Education, Research, Innovation and Science in conjunction with the 16 ETBs in Ireland to coordinate and fund FET courses. The FET sector was created and formed from education policies and workforce strategies as part of the government's reform of public service and provides courses at Level 1 to 6 on the ten level NFQ which are accredited by QQI or other approved awarding bodies such as C&G (SOLAS, 2014). QQI which was established in 2012, is a state agency responsible for quality assurance of qualifications in education and training in Ireland (Walsh, 2017). FET occurs after second level education but does not form part of third level schooling (DES, 2004 as cited by Hardiman, 2012) and offers over 25000 programmes including: Post Leaving Certificate Courses, Back to Education Initiative, Youthreach, Vocational Training Opportunities Scheme, Adult Literacy and Community Education.

There are 64 FET centres offering training and education at Level 5 or Level 6 and 293 community based facilities providing access to education and training opportunities, primarily at Levels 1 to 4 (SOLAS, 2020). The purpose of FET is to facilitate lifelong learning, meet skills deficits in the labour market to enhance employment and to promote active inclusion in society. According to

(Shannon, 2019, p.113) "'lifelong learning' and the economic lens it brought to the formation of policy in the White Paper sowed the seeds for the 'skills equation' in the FET Strategy".

The current FET strategy, 2020 to 2024 is focused on Transforming Learning and the evolution in learning, learners, and knowledge. The strategy identifies six key outcomes for the future of FET; generating jobs, providing learning pathways, active inclusion by receiving certification for levels 1-3 on the NQF, lifelong learning for learners aged 25 to 64, meeting key skills gaps and promoting new models of delivery (SOLAS, 2020). With FET evolving and widening its remit, it is crucial to ensure that the sector remains learner focused and ensures the provision of equal learning opportunities for all learners.

Learners in FET come from diverse backgrounds with various life experience. The SOLAS Strategy (2014) identifies that FET learners may be learners who are returning to education, unemployed, job seeking, early school leavers, an employee or employer, apprentices, school leavers or adults engaging in life-long education. All FET learners will have different motivations for participating in FET courses. Learners may be highly motivated and excel in FET courses or may lack motivation and require additional supports. Therefore, the diverse courses FET offers makes education more accessible, the sector is diverse, encompassing everything from local courses tailored to the needs of the community right through to mature learners going to university.

2.3 Science and Technology in Education

The fields of S&T are emerging and becoming increasingly popular in education. "Science and technology are different but related as forms of knowledge and as forms of activities. Science is concerned about general explanations of reality; technology is concerned about finding workable solutions to practical problems" (Sjøberg, 2003). There are various S&T courses offered in FE at QQI Level 5 and Level 6 Major Awards including Animal Science, Food Science, Laboratory Techniques, Life Sciences Manufacturing Options, Engineering Technology, Computer systems and Networks and Advanced Certificate in Computer Networking/Programming to name a few. In general, QQI Major

Awards, consist of eight QQI Minor Award modules, all QQI Major Awards at Level 5 and 6 entail a soft skills module such as Communications, Personal Effectiveness, Teamworking or Customer Service and a Work Experience or Personal Professional Development module along with course specific modules. In S&T specific modules such as Biology, Chemistry, Physics, Computer Networking etc., the content can be heavily practical, skills specific and require students to be actively hands on using equipment in the college.

There is little literature that exists on S&T in Further Education. According to Sjøberg, (2003), some of the perceptions and challenges of S&T in education were that it was deemed "untrendy" and "difficult" with an outdated curriculum, lack of qualified teachers and a stereotypical image of scientists and engineers leading to a fall in recruitment in S&T subjects in school and in tertiary education. However, these perceptions and challenges have been responded to, to aid in the reform of S&T in education. In recent times in the 21st century, with an increasing advancement of scientific and technological processes, there is a need to create opportunities for high-quality education in these subjects. According to Thibaut et al., (2018), the shortage of graduates in STEM has led to an attempt to increase student demand for these subjects, however as these subjects generally require specific resource materials, integrating STEM into secondary education can be time consuming and costly.

Thibaut et al., (2018) suggest that a framework for integrated STEM education consists of five key principles: integration of STEM content, problem-centred learning, inquiry-based learning, design-based learning, and cooperative learning which are all built on the view of social constructivism. Understanding and applying a framework to integrate STEM education allows for enhanced teaching and learning in this area and leads to an increase in learner's motivation to participate in STEM education leading to a larger number of graduates in these disciplines. It is imperative to look at instructional design in STEM education to ensure learners are provided with the opportunity and motivation to excel in these disciplines while also empowering learners through

inquiry learning. STEM curriculum requires students to be engaged in an experiential learning environment through problem-based, project-based, and inquiry-based activities (ElSayary, 2021). Understanding applicable learning theories allows for optimisation of teaching and learning within STEM.

2.4 Learning Theories and Adult Learning

Learning is a lifelong process whether through formal or informal means. The Learning for Life: White Paper on Adult Education (Department of Education and Science, 2000) defines adult education as "systematic learning undertaken by adults who return to learning having concluded initial education or training" (p. 12). There are various learning theories and orientations of learning that have been widely explored, these include the following:

Behaviourism

"Behaviourism is primarily concerned with observable and measurable aspects of human behaviour" (Zhou & Brown, 2015). Behaviourism is a form of learning that constitutes a change in behaviour, adult learners are generally encouraged to be self-directed and construct their own knowledge however, the behaviourist learning approach is necessary and appropriate in some learning contexts i.e., learning a skill through repition. "In our everyday lives we exhibit changes in behaviour as we move from one group of people to another; for instance, from our professional colleagues at a research conference to our family at a reunion" (Aikenhead, 1996). The primary purpose of the behaviourist learning theory is to elicit change in behaviour, learning involves stimulus and response, with the correct response encouraged by positive or negative reinforcement, this is known as 'operant conditioning'. "In an online learning environment, behaviourism involves chunking curriculum into smaller instructional steps" (Weegar & Pacis, 2012). The principles of behaviourism can be utilised effectively in online learning if educators design activities that condition a response cycle in learners (Arghode et al., 2017) i.e. gamify learning to increase in class competitiveness and collaboration.

Cognitivism

In contrast to behaviourism "cognitivists consider the so called non-observable cognitive process to be central for understanding learning processes" (Bélanger, 2011 p. 22). The process occurs internally as human beings interpret and utilise information differently at different stages of cognitive development, in an educational context instructional design should be tailored to aid learner's cognitive development and enhance creative thinking and problem-solving skills thus proving the need for dynamic content and various modes of learning. "Cognitivists focus on how humans learn and understand using internal processes of acquiring, understanding and retaining knowledge" (Marquardt & Waddill, 2004 p. 188).

Constructivism

Constructivists believe that people do not learn in isolation but rather in collaboration with one another. The constructivist theory allows students to construct their own point of view of the world, philosophy of living, technical expertise, and knowledge structures; it accentuates an individual's learning and social and situational learning experiences (Ouyang & Stanley, 2014). Learners bring previous knowledge and experience to their educational contexts which influences their construction of new knowledge, the outcome of this form of learning is understanding. The theory of social constructivism (Vygotsky, 1962) relates to how learners learn in a collaborative environment from one another, this theory recognises that learners learn at different paces, have different abilities, and can become independent learners through the assistance of others when learning is scaffolded by teachers or peers.

Connectivism

Connectivism is a conceptual framework which views learning as a network phenomenon influenced by technology and socialisation (Siemens, 2006 as cited by Goldie, 2016). It is a framework for understanding learning in a digital age and is mainly concerned with cognitive

development, it is seen as a successor to the previously mentioned learning theories. In the connectivist learning model, the learning community is a node of a wider learning network. Resource materials that provide sources of information are also seen as nodes of this wider learning network, these networks comprise of two or more nodes that are linked to share resources (Goldie, 2016). Successful networks are considered to have the following four characteristics: (1) Diversity; the widest possible spectrum of points of view (2) Autonomy of participants (3) Openness; mechanisms which allow perspectives to be entered into the system (4) Connectivity; connections between its nodes (Downes, 2006, 2012 as cited by Goldie, 2016). In a growing digital age it is clear there is new and emerging pedagogies where control is shifted from the teacher to the autonomous learner, however it can be argued that connectivism is not a learning theory in its own right but rather plays a central role in the development of these new pedagogies (Kop & Hill, 2008). Connectivism is built on the theory of constructivism where learners are still encouraged to construct their own meaning. Connecting to people and resources is happening throughout all learning in our lives and this learning theory allows for accessibility and for educators to be innovative in their teaching practice.

Andragogy

It is widely known that adults learn differently, two learning theories pedagogy and andragogy are often debated, “the pedagogical theory assumes that the student will simply learn what they have been told” (McGrath, 2009, p. 100) while andragogy focuses on learning outside of formal settings and promotes learning as a self-directed process (Tümen Akyıldız, 2019). Malcom Knowles, (1980) Identifies the following five assumptions of adult learning in relation to the theory of Andragogy; (1) Self-concept; adult learners can direct their own learning, (2) Experience; adult learners life experiences aid their learning, (3) Readiness to learn; adult learners are more ready to learn when they acquire new life roles, (4) Orientation to learning; adult learners see learning as a process to aid them in reaching their full potential in life and (5) Motivation to learn; adult learners tend to be more motivated by internal factors rather than external factors.

Andragogy like other learning theories has its associated challenges, Hartee (1984, p. 205 as cited by McGrath, 2009) suggested that Knowles assumptions were based on 'what the adult learner should be like' but that this theory lacked evidence to support it. This is in line with Kerka, (2002) who identified that there are different types of adult learning and the expectations that adults have as learners may differ but that effectively it is not about whether adults learn differently but whether they should be taught differently and that the theory of andragogy is too often uncritically accepted as the assumptions are yet to be backed up with research.

While these learning theories have the same goal of improving learning, the practice of each may not be mutually exclusive. The art of teaching adults therefore requires an understanding of learning theories related to how adults learn to ensure all learners are provided with equal learning opportunities to reach their full learning potential. "Behaviourist strategies can be used to teach the facts (what); cognitivist strategies, the principles and processes (how); and constructivist strategies to teach the real-life and personal applications and contextual learning" (Ally, 2008 p. 39).

2.5 Online learning

Changes in educational contexts has led to an increased demand for flexible learning with many schools and institutions transitioning from traditional face-to-face learning environments to distance learning environments utilising technology. Moore (1990 as cited by James, W. B., Gardner, 1995 p. 23) defined distance learning as "all deliberate and planned learning that is directed or facilitated in a structured manner by an instructor, separated in space and/or in time from the learners". The term distance learning is often used alongside or alternatively to online learning, "online learning is used to refer to web-based training, e-learning, distributed learning, Internet-based learning, web-based instruction, cyber learning, virtual learning, or net-based learning" (Urdan & Weggen, 2000 as cited by Keengwe & Kidd, 2010). Learning through the use of technology can also be referred to as eLearning which is "the use of various technological tools that are either Web-based, Web-distributed or Web-capable for the purposes of education" (Nichols, 2003 p. 2).

The concepts related to learning through technology are interchangeable but effectively refer to the use of technology in learning and educational contexts where teaching and learning is conducted completely or partially through this method. The term blended learning is used to describe teaching and learning that occurs through a combination of distance learning, online learning and some eLearning approaches and face-to-face instruction either in person or through technological means (Nichols, 2003). The term blended learning can also be referred to as hybrid learning. “Hybrid learning should be viewed as an intermediate step between face-to-face and fully online learning environments” (O’Byrne & Pytash, 2015 p. 138). Learning can either be active or passive and instructional design plays a key role in this, active learning is when learners are involved and actively engaged in their learning environment whilst passive learning is when learners are receiving information much like a didactic lecture and are not actively involved in the learning process.

Technology in Education

Technology and education are co-constitutive of each other (Bayne, 2015), the term Technology Enhanced Learning (TEL) subsumes the meaning of “eLearning”, TEL refers to the use of technology and a digital interface in education and how this aids learning. TEL allows learners learn at their own pace, provides more resources for teachers i.e. quizzes etc., keeps learners engaged, allows for flexible learning where thre is little focus on attendance and appeals to a wider range of diverse learners. Kirkwood & Price, (2014) investigated the enhanced element of TEL and found that it can be interpreted differently, these authors reviewed several studies and concluded that many focused on the means of learning through technology: replicating and supplementing existing teaching while fewer considered how teaching and learning with technology impacts the student experience of learning. SOLAS, (2016), the FET Authority of Ireland, implemented a TEL strategy in 2016 to 2019 for using technology to facilitate and support innovative teaching and learning practices to provide greater access to FET, enable learners to be more engaged in their learning and

ensure learners are skilled and confident in the use of technology as part of their work, study and home life.

In teaching through technology there are various degrees of teacher and learner interactions, learners receive clear directions and guidance through course structure and discourse with an instructor in courses with little to no transactional distance, in courses with more distance and no open dialogue with instructors, learners make their own decisions about learning strategies, thus the greater the transactional distance, the more autonomy the learner has to exercise (Moore, 1991). In a study conducted on eLearning in Education, Fitzpatrick (2012 p. 793) identified five key success factors (KSF) for this mode of learning; (1) Technology; availability, connectivity and reliability; (2) Human; pedagogy, attitude and communication; (3) Design; content, interface and framework; (4) Support; training, resources and feedback; and (5) Evaluation; assessment, usability and quality. This KSF model allows for eLearning, online learning, distance learning and blended learning to be implemented effectively ensuring the course design is learner focused. In online, blended, eLearning or distance learning environments, learning can be synchronous or asynchronous. Synchronous learning occurs at the same time face-to-face either in person or through technological means while asynchronous learning occurs at a learners own pace through a means of online or distance learning, aspects of both synchronous and asynchronous forms of learning are the formation of many blended learning courses (Yamagata-lynch, 2014).

Collaborative Learning

While the use of technology in educational contexts certainly allows for flexible learning, it also allows for learners to work in collaboration with one another. Collaborative learning (CL) is typically learner centred and can be described as “an umbrella term for a variety of educational approaches involving joint intellectual effort by students, or students and teachers together” (Smith & Macgregor, 1992 p. 1). In CL, learners share learning goals and rely on one another to succeed, work competitively against each other to achieve select goals or work individually to achieve goals

unrelated to others. One learners actions may promote the success of others, may inhibit the success of others or may not have an effect on the success or failures of others (Laal & Ghodsi, 2012). Within CL there are certain forms of interaction among people expected to occur, which in turn generate learning, however it is no guarantee that these expected interactions will actually occur (Dillenbourg, 1999). Thus, proving the need for proper instructional design in online learning environments to promote collaboration leading to deep meaningful learning.

Universal Design for Learning

Universal Design for Learning (UDL) is an inclusive approach that can apply to the design and delivery of online or blended learning environments, UDL recognises that all learners learn differently and enables content delivery to be flexible to encourage, participation, collaboration, motivation and appeal to the needs of each individual learner and improve the overall learning experience (AHEAD, 2017). Margaret King-Sears, (2009) argues that UDL is not solely defined or confined to technology but rather must be combined with effective pedagogy that can either stand alone as UDL or be utilised in combination with technology for UDL. Instructional design is imperative to a learner's accomplishment in learning. In UDL, "the goal is to provide all learners with equal access to learning with the intention of decreasing barriers for differently-abled students currently built into instructional techniques (e.g., passive lectures versus using videos, graphical representations, and text that appeals to a variety of learning preferences)" (Chen et al., 2018 p. 69). Research shows that active learning may not improve overall mastery of a subject but can lead to improved cognitive outcomes in specific material covered throughout a class (Michel et al., 2009). UDL in online/blended learning environments allows for active learning appealing to a diverse range of learners and aids in the development of higher order thinking, active learning is not an isolated event, but one that requires continuous input from the teacher as the teaching-learning process is pivotal to learning (Phillips, 2005).

2.6 Challenges Associated with Online Learning

There are unarguably positives to the use of technology in education however, there are also challenges associated with this. Kopp et al. (2019 as cited by Adedoyin & Soykan, 2020) discusses five common assumptions that are considered interruptions to successful online learning and digital transformation of higher education institutions as against contributions, these assumptions are related to the following: (i) change, (ii) pace, (iii) technology, (iv) competences and (v) financing digitalisation.

Changing roles

In an online learning environment there occurs a change in teacher and student roles, "both teachers and students take on more complex roles and responsibilities" (Finkel and Monk, 1983; MacGregor, 1990 as cited by Smith & Macgregor, 1992). The classroom becomes a learning community with teachers and all students involved bringing the complexities of a community together, this reshapes student involvement, content design and relationships between teacher and learner and learner to learner. This research is corroborated by Comas-Quinn, (2011) who concluded that in an online learning environment it is necessary to reconceptualise the roles of both teacher and learner, and how they co-construct understanding through synchronous and asynchronous online interaction. A study by Maor, (2003) found that in an online learning environment, teachers and students must both also become reflective practitioners to ensure quality collaborative learning online. This is in line with findings from ElSayary, (2021) who states it is essential to develop digital competencies in STEM education and found that teachers use of a "reflective model organised instructional activities that were done in specific stages to guide students' work" (p. 10).

Teaching with technology is not a one-size fits all approach, alongside the challenges for teachers and students in accepting new identity roles in learning, there are other barriers to engaging with online learning for students. In a study conducted by Song et al., (2004), participants indicated the following as challenges of online learning: technical problems; a perceived lack of

sense of community; time constraints, and a lack of understanding the objectives. Gonzalez, M., & Moore, (2020) conducted a study on both students and faculty perceptions of engaging online courses and found that clear expectations were necessary for students to feel engaged while both faculty and students sought variety in course assignments and activities, student roles, and technology use.

Digital Competence

While online or blended learning methods are flexible and allow learners work at their own pace (O'Byrne & Pytash, 2015), it is necessary that learners have a good level of digital competency to engage with these learning methods, a lack of such skills can impact a learner's experience of engaging with online learning methods. Digital competence is the group of skills, knowledge and attitudes needed when using ICT and digital devices to perform responsibilities, such as problem solving, information management, collaboration with respect to effectiveness, efficiency and ethics (Ferrari, 2012 as cited by Adedoyin & Soykan, 2020). As part of a Framework for Developing and Understanding Digital Competence in Europe, Ferrari, (2013), summarised areas of digital competency as: Information, communication, content creation, safety and problem solving and created a self-assessment grid based on same ranging from foundation to intermediate to advanced.

Communication and Isolation

In an online learning environment, there can be a lack of communication, research shows that students can feel isolated from both their teacher and peers, as there is little to no face-to-face communication with them. Interactions occur primarily through technological means such as email or discussion boards etc. Gilbert, (2015) found that students would prefer more interaction and communication between student and student and student and professor. Zembylas et al., (2008) found the negative emotions associated with adult learners in an online learning environment to be: anxiety related to the unknown methodology of distance learning and the demands of the programme, loneliness and isolation and stress for the inability to fulfil other obligations.

According to a QQI Evaluation report (2020): “The Impact of COVID-19 Modifications to Teaching, Learning and Assessment in Irish Further Education and Training and Higher Education”, both teachers and learners missed the face-to-face interaction of being in a classroom, however learners identified that remote learning provided them with greater flexibility and control in terms of accessing material. The report also stated that “Responses from practitioners, AHEAD and AONTAS suggest that some marginalised and vulnerable groups were particularly disadvantaged by the experience of remote teaching and learning” (p. 4).

Having identified, some of the challenges associated with online learning methods, it is evident that it is imperative for effective course design and teaching practices to be implemented to ensure learners have a positive online learning experience with opportunities to reach their full learning potential.

2.7 Teaching Practices during Covid-19

Teaching through online learning management systems has occurred for years and is not a new concept however, due to COVID-19, a rapid change to teaching was brought about leading to ERE that some teachers, students, and colleges/institutions were not completely prepared for. The transformation process was smooth for some institutions, while some responded with a crisis-response migration process (Hodges et al. & Manfuso 2020). This crisis-response was a shift to ERE, as this was not planned, it differs from the typical idea of distance learning (Toquero, 2020), teachers were less prepared and had to teach innovatively to ensure learning was not compromised.

Hess (1999) states that learning is not a spectator sport; students do not learn by listening and memorising. There should be more emphasis on developing student skills, higher-order thinking (analysis, synthesis, evaluation). Teaching strategies should be based on student focused Learning activities to bring about conceptual change in student’s understanding of the world. According to Galvin & O’ Neill, (2013) online learning teaching strategies should include methods of: (1) Acquisition: using of digital documents, podcasts, videos (2) Inquiry: using digital tools to collect and

analyse data; (3) Practice: using models, simulations, virtual labs (4) Production: through producing digital documents, slideshows, e-portfolios, blogs; (5) Discussion: through online tutorials, email or online discussion forums, synchronous and asynchronous discussions; (6) Collaboration: through group work online, chat rooms, wikis, producing a joint digital output.

Learning STEM subjects at home through online processes can be challenging, Zulirfan et al., (2020) conducted research on this and concluded that online learning for science must prioritise scientific activities and that utilising at home project kits for project based learning can achieve innovative active learning and aid the development of critical and creative scientific skills. The Open University (Agnes et al., 2021) conducted research on innovating pedagogy in the beginning of the Covid-19 pandemic, this research concluded there are various teaching approaches to online learning and analysed the benefits and challenges for each. In science education, "best learning moments may occur in situations involving hands-on activity and participation" (p. 3). While listening, watching, and reading also facilitate learning, "without the elements of appropriate skill and challenge they might not result in learning" (P. 3). Within this study, Virtual Reality was also identified as an important teaching method in science subjects, as it allows learners to be a part of an enriched reality, allowing "experiences that would not otherwise be possible" (p. 10). Inquiry based learning (IBL) is also important in science-based education and helps develop higher-order thinking skills and deep learning. IBL is a learning process in which learners are engaged in active learning and consists of activities in which learners develop knowledge and understanding of scientific ideas and how scientists study the natural world (Anderson, 2002).

Understanding the lack of preparedness for ERE, leads to an unexpected question of whether teachers should be trained in emergency remote teaching? In a study conducted by Trust & Whalen, (2020) investigating lessons learned during the pandemic with regards to teaching, the findings disclosed that the participants lacked the necessary preparation, training, and support for designing quality instruction with technology which created additional stressors and barriers to

teaching and learning remotely in times of need. This creates the assumption that the lack of preparedness of teachers for ERE may have impacted the overall educational experience of online learning/ ERE for learners.

2.8 Educational Learning Experience

According to Biggs (2012), Education is about conceptual change; it takes place when:

1. Learners receive clear objectives of a learning programme and know where these objectives are within assessment tasks.
2. Learners feel motivated. Motivation' is the product of good teaching, not the prerequisite.
3. Learners feel assessments are not urgent but rather feel free to focus on the task.
4. Learners work collaboratively with both peers and teachers as a good dialogue elicits those activities that shape, elaborate, and deepen understanding.

The educational experience is different for all learners, it is a subjective view of the overall learning and educational process. A study by Yair, (2008) identified that students remember instructional episodes as key experiences of their overall educational experience, the study also found that these key experiences occurred when learners were academically challenged and involved in a process of self-discovery. Thus, identifying that cognitive and teaching presence play a crucial role in development of experience in educational contexts.

Community of Inquiry Framework

An educational community are a group of learners who work together and participate in critical discourse and reflection to develop their own individual meanings and mutual understandings. The CoI framework (Garrison et al., 2000) can be used as a framework to understand the aspects of an educational experience in an online/blended learning environment focusing on three interdependent elements; social presence, teaching presence and cognitive presence. The CoI framework is a broad structure of a transactional educational experience that

functions to understand the dynamic for thinking and learning collaboratively (Garrison, 2017, as cited by Gonzalez, M., & Moore, 2020). The goal of this framework is to be able to measure an online collaborative meaningful educational experience while promoting critical thinking. This framework is built on the theory of social constructivism.

The element of a social presence is pivotal in developing a community, learners need to feel they are part of a bigger learning community inclusive of teachers and other learners to enable them to develop trust and avoid the feeling of isolation in an online learning environment. Studies have found that "there is evidence to suggest that the first priority for most students in a formal educational context is shared social identity (i.e., the purpose of the course), and not personal identity (i.e., interpersonal relationships)" (Garrison et al., 2010 p. 7). Sit et al., (2005) found that lack of human interaction negatively hindered learners experience of online learning providing clarity that online instructional design should be tailored to combat this.

Teaching presence includes the design and implementation of a learning course while also providing support and guiding learners on their learning journey. Garrison & Arbaugh, (2007) identified that there are three dimensions within this element; (1) Instructional design and organisation relating to the planning and structure of a course decided by the teacher. (2) Facilitating discourse relating to how the teacher engages learners with the course content and learning process while setting clear learning expectations. (3) Direct instruction relating to the teachers chosen learning activities, focusing of discussions and provision of effective feedforward and feedback to learners.

The cognitive presence element of the CoI framework is concerned with how learners construct and confirm meaning through engaging in discourse and reflection. As previously discussed in this chapter, cognitivism aims to develop higher order thinking through course content and allow learners to obtain knowledge from diverse sources through exchanging information in a collaborative environment. In an online learning environment, cognitive presence also relates to

how learners apply new ideas and connect existing ideas. The CoI framework identifies four unchanging, non–sequential phases in cognitive presence: activation (a triggering event, an evocative and inductive process), exploration, integration, and resolution (Garrison & Anderson, 2003; Garrison et al., 2000 as cited by Gutiérrez-Santiuste et al., 2015).

These three elements of social, teaching, and cognitive presence shape learners educational experience; research shows that applying the CoI framework positively influences learners online educational experiences. An educational experience is shaped over time; it does not consist of short tasks with measurable outcomes but rather is composed of identifiable episodes or phases that are linked together, Dewey identified that in an educational situation there is "a transaction taking place between the individual and their environment" (Hinchliffe, 2011 p. 425). An authentic learning experience involves problems rooted in the real world, learning through inquiry and thinking skills, occurs through discourse among a community of learners and empowers learners (Rule, 2006). Instructional design and facilitation within learning environments should take these points into consideration and encompass this to optimise the learner's learning experiences.

2.9 Summary of Chapter and Development of Research Questions

The literature in this chapter has been rigorously explored and is grounded in established theories. The aspects related to the educational experience of online learning in S&T courses in FE discussed throughout this literature review have led to the formation of the research questions. This literature review identified there was an element of unpreparedness for teaching and learning in online/blended learning environments. This review has also highlighted that little research exists on the student experience of engaging in online learning and emergency remote education and the impact of online learning through a pandemic.

The impact of COVID-19 has led to a change in conventional teaching and learning methods, this research aims to uncover the impact of this on the student learning experience and draw a conclusion on how online teaching and learning in S&T courses/STEM subjects can be tailored to

meet the learning needs of all individual learners to ensure equal opportunities for every student. This research will aim to answer the following research questions:

1. What was the lived experience of students engaging with online learning in Science and Technology courses in an Irish Further Education Institute during Covid-19?
2. How has the learning experience in Science and Technology courses/ STEM subjects been impacted because of this?

In investigating these research questions, this research may also explore and conclude on barriers and benefits to online learning in FE.

Chapter 3: Methodology

3.1 Introduction

Research is the process of acquiring knowledge in a structured systematic way (Khaldi, 2017). A research methodology is an approach to methodically solving a research problem or answering a research question (Kothari, 2004). This study sought to explore two research questions; Firstly, what was the lived experience of students engaging with online learning in Science and Technology courses in an Irish Further Education Institute during Covid-19? Secondly, how has the learning experience in Science and Technology courses/ STEM subjects been impacted because of this? This study was conducted over a period of six months. This chapter sets out the rationale for the research design of this study to include epistemology and ontology, the theoretical perspective (paradigm), the methodology, sampling of participants, data collection, rigour and validity, ethical considerations, data analysis and the limitations of the study. This chapter will conclude with a summary of the overall research design. The 'how' within the research questions suggest that this study will be investigating, revealing, and understanding the lived experiences of students in relation to online learning in S&T subjects. The study aims to ultimately provide information to allow for better instructional design and practice in online learning in this area. Thus, the research design is guided by the most appropriate method to answer the research questions.

3.2 Theoretical Perspective

3.2.1 Understanding paradigms

A paradigm is a philosophical or theoretical framework consisting of a set of beliefs or assumptions that provide a way of understanding the nature of reality and ways of inquiry, these philosophical underpinnings are crucial to understanding the overall perspective for the design of a research study (Rehman & Alharthi, 2016). "A theoretical paradigm is thus the identification of the underlying basis that is used to construct a scientific investigation" (Krauss, 2005, p. 759). "In educational research the term paradigm is used to describe a researcher's 'worldview'" (Mackenzie & Knipe, 2006 as cited by Kivunja & Kuyini, 2017, p. 26). A paradigm consists of different

components including: ontology, epistemology, methodology, and, methods (Scotland, 2012 & Rehman & Alharthi, 2016).

3.2.2 Exploring paradigms

There are different paradigmatic approaches to research including: 1) Positivism, 2) Interpretivism/constructivism 3) Critical Theory (Shah & Al-Bargi, 2013). Exploring these paradigms further, positivism assumes that reality exists interdependently of humans, with an ontological position of realism and an epistemological position of objectivism. Interpretivism is concerned with perception and construction of reality with an ontological positioning of a relativist view and an epistemological stance of subjectivity and construction of knowledge. Critical theory aims to bring about change with an ontological position of historical realism assuming reality is shaped by historical social and institutional structures and an epistemological position of subjectivity where nothing can be researched without being affected by the researcher (Rehman & Alharthi, 2016). In the field of educational research, it can be concluded that the positivist paradigm seeks to generalise observations, the interpretive paradigm aims to understand particular phenomena and subjective experiences, and the critical paradigm attempts to emancipate (Shah & Al-Bargi, 2013).

3.2.3 Interpretative paradigm

Having explored the possible research paradigms in which this research could be conducted, the chosen paradigm for this research was the interpretive/constructivist paradigm as this is the most appropriate to answer the research questions as other paradigms do not allow for the development of a suitable framework to answer these questions. The interpretive paradigm allows for a researcher to fully explore and understand the phenomenon in question, in this case the student experience of online learning. The interpretive paradigm creates the opportunity for inductive research “arguing particulars to general” (Guba and Lincoln, 2001, p. 5 as cited by Abdel-Fattah & Galal-Edeen, 2009) allowing for a phenomenon to be observed. An interpretive study focuses on constructing and understanding or uncovering of the lived experience of individuals with

the researcher's stance being reflexive of their own significance and being in the world, the disciplinary roots of this research process is the philosophy of phenomenology which is the study of the lived experience (Frechette et al., 2020).

3.3 Epistemology and Ontology

Ontology is concerned with what is known, ontological assumptions are concerned with what constitutes reality. In research, the researcher needs to adopt a stance relating to their own perceptions of how things are and how things work (Scotland, 2012). My ontological stance is that of a relativist view that "there are multiple realities because meaning is grounded in experience" (McMillan, 2015, p. 17). I believe there is no shared social reality, only a series of different individual constructions of it.

A person's epistemological values are embedded within and emerge from their ontological values. Epistemology is concerned with interpretivism, how knowledge can be created, what counts as knowledge and what is perceived as knowledge. It is built on the subjectivism of different realities. An epistemological view is concerned with verifying social knowledge through intersubjective corroboration comparing and contrasting participants different experiences of a phenomenon (Mascolo & Kallio, 2020). The researcher and the researched are inseparable, the researcher's beliefs and experiences influence the questions asked and how the findings are understood. My epistemological stance is to understand the relationship between the participants and their own subjective experiences. I believe that each individual participant has their own construction of an experience related to the phenomenon at question, and because of this the focus of this research was on contextualising and making meaning from these multiple perspectives.

I understand experience and knowledge created to be highly subjective but also recognise that it may be transferable and shared in some ways. One of my core values as a teacher is to ensure that all learners have access to equal learning opportunities to reach their full learning potential, my perspective as a science teacher and coordinator of courses in FE, is that it is necessary to explore

the student experience of online learning to understand the individual experiences of students and thus improve pedagogical excellence, enhance the overall learning experience and provide equal opportunities to all learners in this area. As a researcher, I will aim to interpret and explore this particular phenomenon using my own understanding and the understanding of the participants (Al-Saadi, 2014).

3.4 Phenomenology (Methodology)

The philosophy of phenomenology is adopted to understand the lived experience of a phenomenon, phenomenology considers the experiences of different individuals and focuses on what all participants have in common while they experience any social phenomenon (Shah & Al-Bargi, 2013). “Phenomenology is focused on individuals' meaning making as the quintessential element of the human experience” (Patton, 2002 as cited by Worthington, 2013). There are two branches of phenomenology: descriptive and interpretative. Descriptive or transcendental phenomenology involves making sense of descriptions provided by participants and focuses on the experience and how it is experienced while interpretative or hermeneutic phenomenology involves focusing less on the researchers own interpretations and focuses more on describing experiences of participants by searching for themes and interpretively engaging with the data (Sloan & Bowe, 2014).

There are different research approaches within phenomenology, these can be inductive or deductive. Within the inductive approach there are three steps: (1) Observation. (2) Identification of patterns derived from these observations (3) Drawing generalisation on the basis of these patterns. (Khaldi, 2017). The inductive research approach was adopted for this research as interpretivists use the inductive approach instead of the deductive approach because “they tend to see theory as deriving from data collection and not as the driving force of research” (Grix, 2004, p. 108 as cited by Rehman & Alharthi, 2016, p. 56). This study aimed to gather experiences from participants, understand them to develop patterns and devise broad generalisations based on these observations

while maintaining awareness that the lived experience of each participant will be different and highly subjective.

The research methodology of this study was based on the work of Martin Heidegger, a student of Husserl who first developed the philosophy of descriptive phenomenology as a science to describe the essence of phenomena that appears in our consciousness. Heidegger developed his own type of phenomenology that differed in terms of both subject and method, inspiring 'hermeneutic' or 'interpretive' phenomenological methodologies that emphasised how interpretation is key to understanding experience (Gill, 2020). This methodology is ideal to apply in an educational context as it allows researchers to have a deeper understanding and knowledge of new perspectives of human experiences "through interpreting text highlighting the cultural, historical, philosophical, and linguistic characteristics of the research" (Charlene et al., 2017 as cited by Dangal & Joshi, 2020 p. 30). This form of a phenomenological study is suggestive of qualitative data collection methods.

3.5 Qualitative Research

There are two approaches to data collection in research: qualitative or quantitative. Qualitative research investigates the meanings and constructs in which people assign to their experiences, seeking to understand the social world and meanings that are less observable, qualitative research is an inductive approach and focuses primarily on "what", "how" and "why" questions rather than "how much" or "how many" which is the primary focus in quantitative research methods (Tuffour, 2017). As previously mentioned, an interpretive phenomenological study typically lends itself to qualitative methods as it allows for an individual's personal experience with a phenomenon to be explored and understood which is why this research method was chosen for this study. While in social science research, a quantitative approach may eliminate bias and allow researchers to remain emotionally uninvolved with participants (Terrell, 2012), a qualitative approach is founded on interpretivism and constructivism where making meaning and the

researchers interpretation of findings is accentuated (Tungka, 2020) to provide a more in depth understanding of the lived experience of a particular phenomenon.

Qualitative research is participant driven and iterative with the process of data collection focusing on obtaining a rich thick description of individuals experiences, the methods of qualitative research can be reproducible however, the data obtained cannot be replicable due to the influence of the subjectivity of participants experiences (Jameel et al., 2018). Qualitative research can be used as a method for the evaluating of programmes and programme materials providing the participants and stakeholders with immediate feedback upon the completion of the evaluation (Patton, 2002 as cited by Szyjka, 2012). This method was chosen for this study as it provides teachers and students with feedback on how the change to online teaching and learning impacted the students learning experience within S&T courses in FE.

There are many data collection methods within qualitative research that are unstructured and flexible with the most frequently used being participant observation, interviews and focus group discussions however, the most suitable method for phenomenology research has been identified as interviews to extract participant's experiences, perceptions, thoughts and feelings (Moser & Korstjens, 2018). The qualitative method of semi-structured interviews was chosen for this research as this method is the most appropriate to answer the research question and understand a complex phenomenon that cannot be measured quantitatively (Kalu & Bwalya, 2017). While there are challenges associated with semi-structured interviews such as time, this form of direct discourse is an optimum way to gather information as it is flexible and allows participants to speak freely while remaining on topic with the research questions.

3.5.1 Constructing semi-structured interview questions

I adopted the approach of Bearman, (2019) when writing the semi-structured interview schedule which consists of three practical steps; "(1) considering which core event or series of events illustrate phenomena of interest, (2) ordering questions to optimise an intuitive and

conversational flow and (3) refining the schedule through a series of review and piloting" (p. 1) . I firstly chose an area of interest to me and further explored the concept of online learning and the aspects of it in my own teaching and through reading related research articles. I also explored the QQI, (2020) report on teaching and learning during Covid-19 to explore their approach to investigating the impact of online learning for students and teachers to provide guidance. Having also identified the community of inquiry framework as an essential guideline for understanding experiences of online/blended learning environments in my literature review, some of the interview questions devised were based loosely on the areas of social presence, teaching presence and cognitive presence. When developing an interview schedule it is important to develop questions that are open ended and will yield as much information about the phenomenon as possible (Gill et al., 2008), I created 11 questions for the interview schedule (Appendix D) that provided an in depth overview of participants lived experience of online learning in S&T courses in FE and ensured the wording of the questions prompted responses related to the participant's experience. I also ordered these questions to ensure a conversational flow and build a good rapport with the participants.

3.5.2 Piloting interview questions

According to Majid et al., (2017), pilot studies act as preparation for a full scale study in qualitative research to allow for the identification of flaws or limitations in the interview design with a view to improve the questions. This is echoed by Codó, (2008), who also states that piloting is essential to identify flaws in interview design and allow for refinement of questions. The questions for this study were piloted by 2 students in S&T courses in the host FE Institute who provided feedback on any misleading questions or questions that were ambiguous and required further clarification. Due to Covid-19, pilot interviews were not conducted but the students were asked to read through the interview schedule and provide their feedback. This process was informative to me as a researcher and allowed me to modify the interview questions to be clearer and extract thick and rich responses from participants.

3.6 Insider Research

Insider research is research that is undertaken by a person who is part of the organisation in which the study is based, this form of research is becoming increasingly popular in educational research as academics engage in examining their own practice (Fleming, 2018). As an insider researcher, the researcher is already immersed in knowledge of the study. Unluer, (2012) states that it is imperative for researchers conducting qualitative studies in social science to disclose their positionality to make their research creditable. As both a teacher within the S&T department of the FE host institution for this study and a student currently undertaking online learning, I was aware of my own bias within this research. Greene, (2014) identified how research can be influenced by the researchers own position or their own experience and discussed the importance of disclosing positionality within research to ensure that the voices of participants are expressed correctly while also suggesting techniques for overcoming these challenges and aiding in the process of sharing experiences of participants.

Being aware of insider research allowed for me to implement strategies to minimise my own bias such as bracketing (Tufford & Newman, 2012) where I put aside my own assumptions and pre-conceptions and suspended my own judgements about the phenomenon and focused solely on the participant's experience. I outlined my values and epistemological and ontological stances along with disclosing my positionality as a researcher to ensure the reader was aware of my own biases. I also engaged in peer debriefing while formulating the research questions and interpreting participants responses to ensure I was remaining reflexive and minimising my own biases throughout the research process. This allowed for total transparency throughout the research process and ensured trustworthiness within the study. When formulating the research questions, being an insider researcher was a key advantage as I had knowledge of the phenomenon at question and pre-understandings of the types of questions to ask. I collected the research data without prejudice, ensuring not to ask any leading questions and the data was rigorously interpreted focusing only on what participants said.

3.7 Participants and Sample Selection

This research was conducted in a FE college that hosts approximately 1100 students each year. The college provides a range of Level 5 and Level 6 courses from various awarding bodies such as: QQI, BTEC, ITEC and C&G. The college consists of 7 different departments offering courses in the following different areas; art and design, sport, music, computer gaming, science, computing, engineering, social studies, applied psychology, health sciences, nursing, body therapies, holistic health, business, adult leaving certificate, acting, dance, film, tourism, and hospitality. The focus of this study was within the department of Science, Computing and Engineering.

Nonprobability purposive sampling involves intentional recruitment of participants and is typically used in qualitative research, this form of participant selection was utilised for this study affording the opportunity to target specific groups that were relevant to the research area. The inclusion criteria for this study were students currently undertaking courses within the Science, Computing and Engineering department. Purposive sampling can provide justification for the researcher to attempt to generalise findings but may also make it difficult to defend the representativeness of the sample (Sharma, 2017). This research focused on understanding participants individual lived experience of online learning in S&T courses in FE which is why utilising non-probability purposive sampling was the optimum method of participant selection to ensure participants could describe their experience of this unique and specific phenomenon relevant to the research questions (Mays & Pope, 1995).

In seeking participants for this study, students of S&T courses within the Science, Computing and Engineering Department were sent an email consisting of the plain language research information sheet (Appendix A) and consent form (Appendix B) inviting them to participate in the research, this email was sent firstly by one of the deputy principles in the college and then two reminder emails were sent by myself to all students in S&T courses also. In total, four students volunteered to partake in the research study. It is thought, this sample size was sufficient to conduct

a phenomenological study, having a small sample size was feasible given the context of Covid-19 and the time constraints of this study. Guided by Malterud et al., (2016) model for determining sample size in qualitative interview studies, I decided that the quantity of participants was not the sole focus of the sampling process but rather reaching a point of data saturation was, focusing on the interview design rather than the quantities of interviews. Throughout the study, each participant is referred to as participant, A, B, C or D.

3.8 Data Collection

As previously mentioned, the data collection method chosen for this research study was semi-structured interviews as this was deemed the most appropriate method to extract data from participants and allow them to speak freely about their individual experiences of the phenomenon at question. Other data collection methods such as case studies, focus groups and questionnaires were considered but deemed inappropriate to extract meaningful data from participants of the study answer the research questions.

Prior to commencing the data collection, as previously stated, all participants were issued with an advanced information sheet (Appendix A) and asked to complete a consent form (Appendix B) to ensure they understood the purpose of the research study, what was entailed in participating in the study and ensuring they were aware that they could withdraw from the study at any time. Participants were then assigned an interview date and time and asked to sign an additional information sheet (Appendix C) confirming they understood the purpose of the research study, that the findings will be submitted to NCI as part of a dissertation project, that the findings may be shared with the host institution and that they were over 18 years of age and consented for the interview to be visually and audio recorded. The interviews were carried out in the week beginning April 12th 2021. Due to Covid-19 and restrictions in place, all interviews were conducted through MS Teams.

Interview Guide: Before the interviews started, all participants were reminded of the purpose of the research and that the interviews would be video and audio recorded, participants were also told they could receive a copy of the interview transcripts at their request. When conducting the interviews, I followed guidelines based on the work of DeMarrais, (2004), the questions asked were opened ended, concise and clear allowing participants to provide detailed responses and prompted participants to recall experiences encouraging detailed narratives. The interviews lasted between approximately 28 and 41 minutes in length with all participants asked the same 11 questions devised as part of the interview schedule (Appendix D). As the interviewer, I asked prompting questions when necessary to encourage fuller responses from participants. As all interviews were visually and audio recorded, this allowed for the interviews to be played back and manually transcribed creating the opportunity for a more thorough analysis of the data. The recordings and transcriptions of each interview were stored securely.

3.9 Validity and Reliability

This research aimed to comply with Guba and Lincoln's (1989 as cited by Maher et al., 2018) four criteria in relation to research of: credibility, transferability, dependability, and confirmability. In research, the validity and reliability of a study is imperative, without rigour a study is of little value, qualitative research is iterative and requires a constant verification process to help the researcher identify if data collection and analysis strategies are appropriate and when to continue, modify or stop the research process to achieve reliability and validity ensuring rigor of the study (Morse et al., 2002). This relates to the credibility of a study, according to Noble & Smith, (2015) to evaluate credibility in research findings, the researcher must consider the following: (1) Validity: ensuring that the research findings are accurately represented from the perspectives of participants. (2) Reliability: ensuring that the research and decision-making process was transparent and consistent, taking biases into account. (3) Generalisability: considering whether the research process and findings can be applied to other contexts.

A qualitative approach to research is interpretive by nature and produces knowledge based on constructivist perspectives, collecting data with the intent of developing meaning to aid with understanding a particular phenomenon (Creswell, 2003). As a researcher interpreting this data, being aware of your own biases and rationale for decision-making is critical to rigor of the study (Johnson et al., 2020). The quality of any qualitative research finding is extremely important to the credibility of a study thus, it is crucial to ensure the research tools are appropriate to answer the research question. Considering my own potential biases, I ensured I remained reflexive throughout the research process. Reflexivity describes the process in which researchers are conscious of and critically reflective of knowledge produced from research and how that knowledge is generated and constructed throughout the study (Guillemin & Gillam, 2004).

To enhance the credibility of this research, I also utilised some strategies as suggested by Noble & Smith, (2015) which included: being transparent about the research process and outlining reasons for any decisions made with regards to this, disclosing my positionality, debriefing with peers, recording and transcribing the interviews to allow for repeated revisiting of the data and using verbatim extracts from the data to support identified emerging themes. Ensuring participant consent, that the interviews questions were piloted, and that plain language was used in the research information sheets and throughout the interviews also contributed to the credibility of this study.

3.10 Ethical Considerations

As this is a primary research study, the ethical considerations within this research related to protecting human participants. Qualitative researchers must be aware of the implications of their research, according to Mertens, (2012, p. 37) “The ethical principles that guide researchers include respect, beneficence, and justice”. Before embarking on this research journey, I consulted the British Educational Research Association (BERA) Ethical Guidelines for Educational Research and the NCI Ethical Code for Education Programmes Research, considering these guidelines I then set out clear

research aims and objectives. I then sought ethical approval from the ethics committee at National College of Ireland and permission from the host Institution of FE to conduct the study, both of which were approved in January 2021 before conducting the research study. I applied all ethical guidelines throughout the research process. Govil, (2013), states that educational research has capabilities of improving the lives of individuals, communities and societies therefore ethical consideration must be at the core of educational research. Throughout this research, it was my duty to all participants to ensure that all research was conducted ethically, respectfully and was appropriate to answer the research question i.e. I ensured that the focus of the research remained on participant's experience of online learning.

I firstly provided participants with an outline of the requirements of the study detailing what would happen to the data collected to ensure they were fully informed to decide to partake in the study before asking them to sign a consent form if they wished to partake in the study. The invitation to participate in the study was sent to all students of science and technology subjects in the FE Institute for inclusivity. Maintaining confidentially and ensuring anonymity of all participants was a primary focus throughout the study while also respecting autonomy, ensuring that participants knew they had the right to withdraw from the study at any time. When conducting the interviews, I acquired written consent from participants to record the interviews in both video and audio format and any identifiable information was redacted from transcripts of these interviews. Through the research and data analysis process, I was committed to sharing the true findings of this research.

3.11 Data Analysis

Data analysis involves "working on data" to organise and interpret the data and involves two stages: (1) data reduction and pattern identification (2) producing objective analytic conclusions and communicating those conclusions (Caudle, 2004). The data analysis method chosen influenced the data collection method in the research planning stage of this study, there are various forms of data

analysis which can be adopted in phenomenological qualitative inquiry such as Interpretative Phenomenological Analysis (IPA), Grounded Theory (GT) or Thematic Analysis (TA) to name a few. Evident from a study conducted by Spiers & Riley, (2019), TA can be adopted to explore the experiences of participants allowing for pragmatic findings which may provide broader results such as barriers or facilitators to a phenomenon while the method of IPA may provide existential concerns related to the phenomenon. Thematically analysing the data collected allows for a thick rich description of each participant's subjective experience. Given the time frame allotted for this research this method was deemed the most feasible and appropriate to answer the research question while it is also recognised as one of the most suitable methods of data analysis for a novice researcher.

Clarke & Braun, (2014) define TA as a method for recognising, analysing, and interpreting meaning (themes) from qualitative data, TA involves identifying codes within the data which are the building blocks of the emerging themes. TA allows key features of the data to be organised and interpreted guided by the research question while remaining a very flexible tool. For this data analysis process, I followed the six phases of TA as outlined by Braun & Clarke, (2012):

Phase 1: Familiarisation with the Data

I firstly revisited the recordings of the interviews and read the interview transcripts to become familiar with the data. I made notes as I went through the data for each participant searching for corroboration and highlighting key areas of interest. Throughout this process, I remained open-minded and reflexive and tried to make sense of the data. TA focuses on trying to understand and make meaning of the data rather than measure the frequency of it, themes derived from the analysis are grounded in the experience of the participants (Lindberg et al., 2019).

Phase 2: Generating Initial Codes

Having looked at the data, I then generated initial codes from the data looking for a feature within the data that was potentially relevant to the research question. The data was coded in chunks rather than coded line by line, I coded the data from each participant including only what was possibly relevant to the research question and merged all codes together with the supporting interview data as seen in Table 1. The data was revisited until the initial coding of all potentially relevant information from all participants was coded.

Initial Code	**Interpretation of Interview Data (essence)**
Lack of Social Interaction	Isolated Work focused interaction with peers
Independence	Creating independence Conducting research
Increased anxiety	Spotlighted on video calls
Lack of practical skills	Loss of instinct to prepare for practical experiments Not physically able to perform practical STEM skills Learning of practical STEM skills inhibited
Future of blended learning	Preferred in practical areas, theory classes preferred online Practical classes preferred to take place in the college
Flexible learning	Greater freedom No travel Opportunity to move country
Valuable life skills	Improved digital literacy Use of new software platforms Increased use of technology
Technological issues	Wi-Fi glitches Software issues
Self-regulated learning	Sufficient content provided through online learning platform Additional research to supplement learning
Quick Reponses	Efficient and effective communication with teachers
Challenges	Need for organisation Easy to get distracted Constant interruptions

Table 1. Initial coding of data

Phase 3: Searching for Themes

In this phase of data analysis, themes were constructed from the data based on the initial codes generated. I reviewed the coded data and looked for similarity to determine if any codes could be clustered together or collapsed. I then started the process of generating themes and subthemes, which involved collapsing or clustering codes that shared a unifying feature so that this would reflect coherence within the data and create a pattern of meaning. The themes and subthemes generated from the data are shown in Table 2.

Themes	**Sub-themes**	**Codes**
Communication as an invaluable feature of online learning	Isolation Collaborative learning Communication Teaching & social presence	Lack of social interaction Quick responses Increased Anxiety
Skill sets in online learning	STEM skills deficit Enhancing valuable life skills	Lack of practical skills Valuable life skills Technological issues Future of blended learning Challenges
Empowering learners through online learning	Creating independence Changing roles Cognitive presence	Greater flexibility Independence Self-regulated learning

Table 2. Themes and sub-themes generated from initial codes

Phase 4: Reviewing Potential Themes

Throughout this phase, I checked the quality of the themes generated to determine if these are really themes i.e., do they tell me something useful related to my research questions. I also checked that there was enough data to support the generated themes and that they provided a thick description of the experience of the phenomenon at question.

Phase 5: Defining Themes

In this phase, the uniqueness of each theme identified. I determined if each theme could be summed up in a few sentences, ensuring themes were focused and not repetitive while directly addressing the research questions.

Phase 6: Producing the Report

The reporting of the themes occurred throughout all phases of the data analysis process. The emergent themes were explored and discussed in detail in a logical manner documenting the lived experiences of participants in relation to online learning in S&T subjects in FE. The data analysis process allowed for a story to be told, each theme was rigorously investigated with arguments made within each to answer the research questions as will be shown in the findings and discussions chapter.

3.12 Limitations

This study focused on the lived experience of individuals. As with all research, this study was met with several limitations, firstly this study was confined to a particular demographic of S&T students in a FE setting thus, it must be reiterated that the findings are not representative of anything outside this context. This was a phenomenological study meaning that the findings are highly subjective based on each individual participant's experience and cannot be generalised. Due to Covid-19, it was also difficult to recruit participants for this study, resulting in a small number of participants taking part, although themes were identified from the data extracted, more participants may have allowed for a more holistic view of the research area. Being an insider researcher as previously disclosed also meant I carried my own biases with me throughout the research process whilst taking steps and employing strategies to eliminate this as much as possible. As a researcher I was not well versed in interview techniques, although this improved throughout the interviews, meaning that I potentially did not extract as much data as was possible from the participants. In addition, the time constraints under which this study was conducted meant that only a small-scale

study with a concise data analysis was feasible and that all literature pertaining to this research area was not explored. If there had of been a longer time frame allotted for this study to be conducted, a more in-depth research process could have been applied. Identifying the limitations of this study has allowed for validity of the findings and knowledge produced and allowed for recommendations to be synthesised which will be discussed in the Conclusion, Recommendations, and Implications chapter.

3.13 Summary of Chapter

This chapter outlines the research process that was conducted and discusses the rationale for decisions made relating to this along with the identification of the researcher positionality. This chapter allows for transparency and credibility within the research study while also detailing the sample selection, data collection, data analysis, ethical considerations, and limitations of the study. A phenomenological qualitative inquiry using semi-structured interviews and thematic analysis was utilised with the major themes identified as (1) Communication as an invaluable feature of online learning. (2) Skills sets in online learning. (3) Empowering learners through online learning. These themes will be further explored in the following chapter of findings and discussions.

Chapter 4: Findings and Discussion

4.1 Introduction

This chapter reports and discusses findings that emerged from the interviews and thematic analysis process previously discussed in chapter three, there were three themes identified as significant as depicted in Figure 1 below. This chapter seeks to explain the lived experience of students engaging with online learning in S&T courses in FE during Covid-19 while also detailing how online learning in these courses and STEM subjects has impacted the learning experience. This chapter aims to develop insights into the experience of participants with a view to improving online pedagogy in this area, enhancing the learning experience, and providing equal opportunities for all learners. It was beneficial to me to have explored how adults learn, online teaching practices during Covid -19 and the contributing factors to an educational experience as part of my literature review, to gain a deeper insight into this phenomenon as this aided my interpretation of each participant's experience. The essence of each theme will be explored and discussed in depth and include verbatim quotes from the interviews to ensure the true experiences of the participants are represented. The data analysis process identified that all participants were partaking in S&T courses in FE using MS Teams as the main platform to access and engage with course content. All participants were completing 8 to 10 modules to include a variety of the following subjects: Maths, Chemistry, Biology, Microbiology, Physics, Mechanical Electronics, Computer Aided Design, Food Processing, Food Safety and HACCP, Nutrition, Dietetics, Work Experience and Communications.

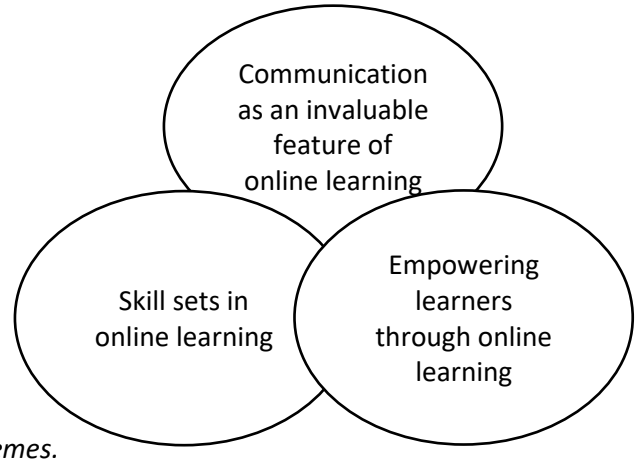

Figure 1. Identified themes.

4.2 Theme 1: Communication as an Invaluable Feature of Online Learning

The prominence of communication emerged as a key theme from the data analysis process. This theme pertains to the importance of social presence in an online learning environment. Communication can be defined as the sharing of information to create a shared understanding, it may be intentional or unintentional and may take linguistic or non-linguistic forms (Velentzas & Broni, 2014). Communication in educational contexts occurs in various ways, this study highlighted that communication in an online learning environment occurs mainly through student-to-student interactions and student to teacher interactions. In this context, participants did not expect to be engaging in online learning but rather it was imposed upon them due to Covid-19.

The change to ERE occurred suddenly and participants felt they were sharing this new experience with their peers and teachers and these synchronous and asynchronous interactions were deemed essential to participants learning experiences. Participants reported that they found the teaching like that of a classroom in terms of content and that communication with their teachers and peers aided their learning and made it easier to understand course content. Overall, participants expressed that the greater the level of communication and interaction, the more positive their learning experience was.

"There is conversational interaction, but like you miss out on nuances, stuff like body language." – Participant C

"*You just don't really feel as motivated, and you don't really get to know the people who you're in the course with so it can kind of be a bit isolated.*" *- Participant A*

Participant C reported finding the lack of face-to-face interaction as something they disliked about online learning while participant A related to the isolation that can occur in an online learning setting due to a lack of social contact. This is in line with research conducted by Sit et al., (2005) which identified how the lack of human interaction negatively hindered learners experience of online learning. Thus, further proving the value of good communication in this setting.

Participants also stated that because they did not meet up regularly with their classmates in the college for classes, most student-to-student interactions that occurred were through platforms such as WhatsApp. Participants discussed how the main topic of conversation with their peers was related to coursework and assignments and not about socialising as would be expected. It was clear that this meant it was difficult for participants to develop meaningful friendships leading to a further feeling of isolation.

"It's just not being able to meet up with mates and not being able to actually make mates" – Participant B

"When your online it's more of a communication just between an individual student and the teacher but when you're in the classroom it kind of feels like everyone is doing it together" – Participant A

"There have been instances where, like we like we ask different questions and then someone gets a different answer to someone else, and then we all like explain like how we got to that conclusion." – Participant D

However, most participants felt that online learning led to a form of CL which aided their learning by having other people to share questions and thoughts about coursework with while participant C identified that at times CL was challenging and time consuming to organise group work through an online platform. Participant A relayed how important it was to create a competitive environment for them to learn, which could be achieved through an online learning environment and keeping in contact with peers about the coursework. The findings of this study related to CL are in line with what would be expected in an online learning environment where students rely on each other to succeed academically either through working together or working competitively against each other (Laal & Ghodsi, 2012).

While interaction with peers was much discussed, participants relayed that student to teacher interaction was also important for their learning. All participants stated that the course

content that was available on the MS Teams platform was adequate for their learning, but it was apparent that they felt the element of teaching presence was necessary to help them succeed and reach their full learning potential within the course.

"For me personally a teacher has always had huge impact on my learning" – Participant A

"If there's ever a question or anything like that or if there's ever anything like you're struggling with, like the hand will go out straight away and they'll, they'll guide straight away". – Participant C

This study found that teachers were very supportive with coursework, were deemed necessary to facilitate class discussions and generally available for meetings to discuss coursework/assignments outside of class times. Participants felt that teaching presence was needed as an element of communication to facilitate learning, not just to provide information and go through PowerPoints but to discuss the class content in a conversational manner and facilitate discourse. This reiterates the importance of the 3 roles relating to teaching presence of planning of instructional design, facilitating discourse and direct instruction relating to course learning activities (Garrison & Arbaugh, 2007). It was evident that learning was scaffolded by teachers but it was also recognised by Participant C that in an online learning environment it is more difficult for a teacher to pick up on social ques as to when a learner may be struggling with coursework. Suwastini et al., (2021) emphasised the importance for online instructors to integrate scaffolding strategies in their instructional design to regulate student learning and help students build autonomy in learning online as these are key factors of a successful online course.

Some participants felt that it was easy to communicate with teachers and that responses to emails/messages were prompt however, others felt responses were scattered and occurred at various times of the day which left them waiting around for responses and felt their queries would be more efficiently answered if they were in a classroom environment.

"It feels a little bit more spotlighted when you're on a call rather than when your just in person" – Participant A

"You can see that they're, they're struggling in their own way" – Participant D

The feeling of anxiety is common in an online learning environment (Zembylas et al., 2008), while partaking in classes through the MS Teams platform, participant A reported feeling spotlighted on these calls leading to a feeling of anxiety and other participants alluded to not wanting to turn their camera on or ask too many questions. In some cases, participants sensed a feeling of anxiety and unpreparedness from their teachers leading back to the question of whether training in delivering ERE is necessary and whether teachers need more skills development in the use of digital platforms.

As previously identified in the literature, students would prefer more interaction and communication between student and student and student and professor/teacher (Gilbert, 2015). These interactions are a vital part of the learning experience, especially in this context as the change to ERE was unexpected and a new experience for all learners and teachers. Participants felt that the elements of competitiveness and collaboration in their learning were motivational but that a classroom environment would be more engaging and interactive in terms of communication with both teachers and their peers and class content.

4.3 Theme 2: Skill Sets in Online Learning

Another emerging key theme that arose from the data analysis process was the related skill sets in an online learning environment. A skill is the ability to do something well while a skill set relates to a range of skills or abilities. This theme pertains to the skill sets acquired or missed out on through online learning. The various skills recognised as essential for the 21st Century are: problem-solving, ICT operations and concepts, communication, collaboration, and information literacy (Suto & Eccles, 2014). In learning STEM subjects, it is also essential that practical skills are acquired for the proper functioning of related STEM equipment, as previously identified in the literature review

chapter, students learning STEM subjects should be engaged in an experiential learning environment through problem-based, project-based, and inquiry-based activities (ElSayary, 2021). This study found that in an online learning environment there was a lack of practical activities leading to a skills deficit in this area. However, this study also found that skills were developed in the areas of digital competency, organisation, and cognitive thinking.

The purpose of FET is to meet skills deficits in the labour market and meet key skills gaps (SOLAS, 2020), however, through this research, It was overwhelmingly clear from discussions with the participants that they all felt they had not developed the practical skills necessary in STEM subjects and courses. All learners felt that through partaking in S&T courses in an online learning environment that they had lost the opportunity to develop the necessary key practical skills required in this area leading to a skills deficit. As STEM subjects are practical by nature, they require students to learn skills that can be applied in a workplace context or develop basic key skills that can be built upon through further education, all participants told how they were expected to learn some of these skills through watching YouTube videos and felt this was not appropriate for their learning in this area.

"It's like really difficult to get an understanding of what's happening". -Participant D

"You kind of lose that instinctive thing to you know set up your experiment, get it all done, record everything you know it's kind of almost the next year were in you have to relearn it or just kind of get used to it again" – Participant A

"You're losing the practical element" – Participant B

One participant expressed their concern at having lost the instinct to prepare for basic experiments required in science, this concerned them as they felt they would fall behind in their future education in this area. Other participants were concerned that they were not learning the required skills and were not developing an understanding with regards to these practical skills thus

limiting their learning. Learning skills related to STEM subjects is difficult through an online environment and project based learning kits/ activities should be utilised to ensure students are not disadvantaged in this area (Zulirfan et al., 2020). Simulations through the use of Virtual Reality could also be utilised to help combat this as it immerses users in an enriched reality allowing experiences and learning activities that would otherwise not be possible to take place (Agnes et al., 2021). The findings of this study demonstrate the importance for teachers to be able to teach STEM subjects and related concepts through both an in class and online learning environment. It is essential that learners are engaged in an authentic learning experience to gain skills (Rule, 2006). Again, this relates to the earlier assumption that the lack of preparedness of teachers for ERE may have impacted the overall educational experience of online learning/ ERE for learners.

While participants were disappointed in the lack of opportunity to develop practical STEM skills, they had all developed other invaluable skills through engaging with the online learning process and overcoming associated challenges. The lack of or ability in digital skills impacts on the learning experience, the findings of this research were that all students already felt they had a good level of digital literacy prior to partaking in the FE course but that this had improved through the duration of learning their course content online. Due to the increased use of technology in education (TEL), the level of digital competence overall or in relation to the use of specific platforms improved for all participants.

"I'm very much more comfortable using my laptop or in regards to like doing assignments "– Participant D

"I feel like I'm at the same level and like I've always been at a high level and if anything, I just learned Microsoft Teams" – Participant B

Participants described how using technology and using specific platforms related to online learning in this context i.e., Microsoft Office 365 platform more often led to them building knowledge and competence. Digital competence as defined by Ferrari, (2013) ranges from different

levels of intermediate to advanced, as participants were comfortable with the use of computers prior to commencing the course they had pre-understandings of digital technology which aided their learning. In an ever-changing digital world, it is necessary for these skills to be developed and built upon.

The challenges associated with online learning were evident through discussions with all participants, these related to technological Issues, organisation, and distractions. While all participants voiced their dislike of these elements, there was an overriding feeling that through dealing with these challenges and overcoming these that key life skills relating to resilience and persistence were developed. Participants continued with the learning of their courses online and overcame these challenges and disruptions to their idea of the "ideal" learning environment.

"You definitely have to be extremely organised to do the online learning" – Participant A

"You really need to force yourself to sit back down after, after the day is done and go again. You know, spend the two hours and just get over that hump." – Participant C

Participants had to learn key organisational skills through setting up appropriate workspaces and segregating time for personal life and college work. This involved all participants recognising and creating the best learning environment for themselves that was possible in the circumstances. Participants also felt they were exposed to more distractions in their new learning environments engaging with online learning than they would be in a classroom environment, and it was evident that they thought this affected their concentration and sometimes disrupted their learning. It was clear to see that participants had to develop key skills in retaining their motivation to engage with online learning and overcome these distractions from learning.

Learning, especially in S&T courses/STEM subjects should be focused on developing student's skills through a process of active learning as students are more engaged when discussing concepts or applying them (Hess, 1999). Overall, it was apparent that participants had gained the

necessary 21st Century skills as identified by Suto & Eccles, (2014) through engaging in online learning exceling in some areas over others. While participants found the challenges of online learning demotivating at times, it was the consensus among participants that a future of blended learning in this area of S&T would be preferred with the learning of soft skills modules taking place online while modules with elements of practical skills would take place face-to-face in the classroom. Participant C however, felt they did not specifically like online learning and would prefer classes to be conducted solely face-to-face in a classroom environment with no element of online learning. Having had a conversation with each individual participant about their own experience, it is clear that online learning is not just about learning course/module content but also about acquiring and developing life skills that may apply to other contexts.

4.4 Theme 3: Empowering Learners Through Online Learning

The final emerging key theme from the data analysis process was empowerment, this theme relates to how online learning created the perfect environment for empowering learners. Empowerment has many definitions as identified by (Ibrahim & Alkire, 2007), it can broadly be defined as a person developing the capacity to make effective choices and have the power to take more control over their lives to transform those choices into desired actions and outcomes. This study found that online learning allowed learners to gain confidence and independence in themselves and their learning. This idea of online learning empowering learners was an unexpected find that was not identified through the researched literature.

All participants had engaged in some form of online learning before commencing their courses in the FE institute with participants A & D having completed classes for their leaving certificate online in 2020 while participant's B & C had engaged in online courses in other areas unrelated to STEM subjects. All participants had some expectations of online learning, participant B felt the course in S&T would be more challenging than previous online course undertaken, participant A thought that learning online would be highly interactive with a lot of quizzes,

participant D also thought online learning would be quite interactive and consist of many class calls while participant B felt they had no high expectations for online learning but felt it just had to be done under the circumstances. Through these discussions with participants, it was clear that it may be helpful for colleges and institutions to set out clear expectations of what online learning will entail for prospective students affording them the opportunity to plan for their learning thus further empowering them.

"You can go get a coffee or you can chat to someone in your family, or you can get something done that maybe you need to get it done at home" – Participant A

"It also gave me the benefit to move country" – Participant B

"The only benefit is that I don't have to travel for an hour to get home from college, but I wouldn't even mind that" – Participant C

As previously discussed in the Literature Review chapter of this study, there is greater flexibility in online learning which allows learners to work at their own pace (O'Byrne & Pytash, 2015) thus giving learners more autonomy in their learning. In this study, the findings were in line with the literature, participants identified that online learning was flexible and provided them with more freedom in their personal life. One participant expressed their content that because of online learning they could move to a different country and continue with the S&T course they were completing. Other participants reported their happiness that they could plan their days around their learning and felt they had more time in their days to focus on other aspects of their lives. Except for participant C, who indicated that while they thought the flexibility and lack of travel was a benefit to online learning, overall, they felt this did not outweigh the associated negatives and challenges for them.

In an online learning environment, there is a change of roles for both teachers and students where how knowledge and understanding is created needs to be reconceptualised as identified

previously by Comas-Quinn, (2011) . Throughout the interviews, it was apparent that the participants felt they needed to take on a new role in online learning. There was an overriding feeling that participants wanted to continue with their online learning and make the most of this unexpected situation, because of the sudden migration to ERE, learners were thrown into the deep end and had to adapt quickly to a new form of teaching and learning. In my own view, participants adopted a readiness and willingness to learn in this new form, taking responsibility for their own learning, however, it was not obviously apparent that learners were aware of this new role. As previously discussed, learners also felt that their teachers had adopted a role of facilitating their learning through being on this journey of ERE with them and acknowledged that this was a new experience for them too.

"I'm grateful and thankful that I have them there and like this online learning is a thing because without it like I'd be put back a year in life" – Participant B

"I would have expected it to be worse almost, but so far like … I've gotten, I've gotten good grades, I'm very happy with that." – Participant D

This crisis migration response (Hodges et al. & Manfuso 2020) to ERE, was a unique challenge aside from the recognised challenges of online or distance learning. This was an unprecedented experience in teaching and learning and created an environment where learners could be proud that they were achieving their qualifications despite the disruption to teaching and learning caused by Covid-19. Findings from this study, also relate to how online learning helped create independence within participants through providing them the opportunity to take responsibility for their own learning and engage in self-regulated learning. This is consistent with the findings of Atmojo et al., (2020) who found that online learning can make students more independent in learning, have self-awareness, and good learning achievement.

"You kind of have to sit down, figure it out yourself first or maybe go research it yourself and maybe you find things out yourself you know so it could be that there's a lot more independent learning" – Participant A

This independence stemmed from the cognitive presence in an online learning environment with participants given the opportunity to develop critical thinking and research skills. One of the participants reported that due to less participation in MS Teams calls and online learning than that which would occur in a classroom environment, course content was covered quicker, and classes may finish earlier, leaving time for learners to conduct their own study/research for assignments. This again could be due to a lack of planning by teachers, further alluding to the fact that teachers may need to be trained to deliver ERE successfully. Also, participants felt they needed to figure things out for themselves and conduct their own research on topics because they were not physically in the lab conducting a practical skill or experiment with a teacher. This again demonstrates how online learning prompted participants to take accountability for their learning.

"I would refer to the notes as well, but other, other times I would like do my own research and try to find other research sources as well to kind of get like more of an understanding of the topic as well.": Participant D

Participant B disclosed that they have dyslexia and discussed how due to a lack of proper learning support available through online learning that they started to rely more on themselves and gain confidence in their ability and their work developing independence, self-belief, and a sense of accomplishment.

"I couldn't get the help I needed there, that was challenging because it was like right, I have to keep pushing myself that little bit harder to do it but, in a way, it was beneficial because I did push myself and I was actually like I actually did that, and I got that grade" – Participant B

Interestingly, although literature exists on the benefits related to flexibility and self-regulated learning in online learning, there was no identified literature relating to how online learning empowers learners and helps learners develop and learn more about themselves. While participants were empowered and could take control of their own learning through engaging with online learning it was evident there was lessons learnt. Participants were asked what advice they would give to their future selves or prospective students of online learning in S&T courses. The advice participants would offer pertained to firstly, organisation and how important it is to have a defined workplace to separate personal and college life and secondly, the importance of asking questions and participating in online classes which participants felt would make the learning experience less challenging and more enjoyable.

"The separation of like home and college just makes life a lot easier" – Participant C

"I'd say definitely like don't be afraid to ask a lot of questions because it is like a very difficult situation, and that's kind of something I kind of regret like." –Participant D

Overall, as unexpected as ERE was and as unexpected as the findings of this theme were from the research study, it is unmistakably clear that online learning was an eye-opening experience for all participants and benefited them through enhancing valuable life skills and creating independence and confidence in their learning. This empowerment will provide a core foundation for participants in their future learning and work-related endeavours as they are now more aware of how they learn.

4.5 Summary of Chapter

This chapter discussed the three key themes that emerged from the data analysis process. The experience of participants was that online learning had positives and negatives as expected from previous studies conducted in this area (QQI, 2020). There were expected themes identified pertaining to communication and skills sets in online learning along with an unexpected theme that emerged relating to online learning as a tool for empowering learning. Identifying an unexpected

theme in this research perhaps creates the opportunity for future research in this area. Also, as Covid-19, a worldwide pandemic occurred suddenly and is still ongoing, there may be literature and relevant research studies continuously emerging that should be referred to. Throughout this study, it was clear to me that for participants engaging in online learning, it was a learning experience aside from learning course content. However, regardless of the sudden change to ERE, it seemed that participants felt it was a successful process and felt they were academically achieving well.

To conclude, the consensus among participants was that ERE and the change to online learning was not expected but that this created a supportive environment between students and students and students and teachers. Participants expressed that communication was an essential factor to their learning, it was apparent that participants missed the expected typical interactions with their peers and that they saw the teacher as the facilitator for online learning and felt it was necessary to maintain good communication with them. This relates back to the ability of teachers to organise and deliver successful online learning.

One of the overriding feelings among all participants was how the opportunity for them to learn key practical skills associated with STEM subjects was lost because of online learning leading to a skills deficit in this area. As S&T courses and STEM subjects are so practical by nature, this concerned participants as they felt these were the fundamentals necessary in their learning and did not want to miss out on acquiring these skills for fear it could affect their ability in their overall qualification or future learning in this area. Participants also reported engaging in online learning was boring, fatiguing, and de-motivating at times. However, in saying this, it was obvious that participants had developed other essential life skills i.e., digital literacy and organisational/planning skills and participants also learned ways to overcome challenges that they felt hindered their learning which will benefit them in their future lives.

The flexibility that online learning offers, lead to participants taking control of their own learning, creating independence. There were lessons learnt through engaging with online learning

which allowed participants to learn aspects they like and dislike about online learning and understand how they learn and the best environment for this which may be beneficial to them in their future learning thus further empowering them in their own learning.

While there were positive and negatives to participant's experience of learning S&T courses and STEM subjects online, overall, most participants expressed that a future of blended learning was preferred. As previously mentioned, a blended learning environment for future learning would be preferred by most participants, with participant C preferring all learning to take place in a classroom environment as they felt this was more structured for their learning. This study has provided insights and the prospect for further research in S&T to improve online teaching and learning and provide greater opportunities for online learning to be tailored to meet the needs of each individual learner.

While it could be argued that there is potential conflict between themes one and three, I did not perceive this. Theme one relates to the value of the relationships developed between students and teachers and students and their peers while engaging with online learning whereas theme three pertains to how learners were empowered through the cognitive ability that was developed through online learning.

Chapter 5: Conclusion, Recommendations, and Implications

5.1 Introduction

This chapter draws conclusions on the research study detailing the lived experience of students in S&T courses in FE engaging with online learning during Covid-19 and how the learning experience was impacted because of this. The chapter provides an overall conclusion to the dissertation, discusses the implications of this research study, provides recommendations for future research in this area and includes a personal reflection of the research process.

5.2 Conclusion

This research journey started with an extensive review of literature to understand FE, STEM education and adult learning online, the review of literature also focused on the constituents of an educational experience and the change to teaching practices due to Covid-19. As a teacher of Science in FE, I was intrigued to understand the lived experience of S&T students in FE who engaged with online learning during the Covid-19 pandemic. To achieve this understanding, a qualitative methodology was availed of to provide a thick rich interpretation of the findings, rather than numerical expressions of data that would be achieved through a quantitative study. It is pertinent to note that this study was conducted during Covid-19, a worldwide pandemic and that the findings of this research process are only applicable to a particular context. This research has provided invaluable information for the FE community, the knowledge gained is from the lived experience of four participants, but also provides a broad insight into the facilitators and barriers of online learning in S&T courses in FE.

Due to Covid-19, there were various limitations to this study as previously discussed in chapter three. I believe the most appropriate method to understand the lived experience of students was adopted. This phenomenological qualitative inquiry aimed to answer two research questions: (1) What was the lived experience of students engaging with online learning in Science and Technology courses in an Irish Further Education Institute during Covid-19? (2) How has the

learning experience in Science and Technology courses/ STEM subjects been impacted because of this? As outlined in the Methodology chapter, the findings of this study were corresponding with the COI Framework (R. Garrison et al., 2000) utilised to understand the educational experience of online/blended learning environments. The 3 elements of this framework: teaching presence, social presence and cognitive presence were all identified as essential factors contributing to successful online learning and enhancing the overall educational experience within online learning. The findings of this study were separated into 3 key themes: (1) Communication as an invaluable feature of online learning. (2) Skills sets in online learning (3) Empowering learners through online learning. Each of these themes have been rigorously explored and discussed in the Findings and Discussion chapter of this dissertation.

To answer the first research question, the lived experience of participants was that online learning had positives and negatives associated with it. Students were willing to engage in online learning and with various digital platforms but felt demotivated and fatigued at times however, enjoyed the flexibility of online learning. One of the most evident factors was the importance and the need for communication with both students and teachers in an online learning environment to enhance learning. Participants felt that the more social interaction present, the more positive their learning experience was. It was also found that online learning created the opportunity for participants to develop essential 21st century skills of problem-solving, ICT operations and concepts, communication, collaboration, and information literacy (Suto & Eccles, 2014) and helped them develop valuable skills in the areas of organisation, planning, resilience and motivation. The unexpected find from this study was that online learning empowered learners allowing them to take greater control over their learning and understand how they learn. Online learning created the opportunity for learners to develop their capacity for self-regulated learning increasing their self-awareness and learning achievement (Atmojo et al., 2020). To provide response to the second research question, specifically related to how the learning experience was impacted in STEM subjects, learners felt they were academically achieving well but the overriding impact of online

learning in S&T courses was the creation of a skills deficit in key practical areas of STEM subjects. This, however, could be combatted in the future through project-based learning and simulation of skills.

This study has identified the facilitators and barriers to online learning in S&T courses in FE, the lived experience of participants that was explored now during Covid-19 may differ to participant's future educational experience learning online as they may now be more prepared and aware of what to expect in an online/blended learning environment and now better understand how they learn. The findings of this study can be used to understand the online learning experience of students and improve online pedagogy based on this. As stated from the onset, one of my core values as a teacher is to ensure that all learners have access to equal learning opportunities to reach their full learning potential and I believe that this can be achieved through online learning and that the findings of this study can provide information to tailor online learning to meet the needs of individual learners.

Overall, online learning was identified as a somewhat successful process in this context however, this study demonstrates there is more work to be done and more lessons to be learned in delivering practical subjects and skills and has provoked the question of whether teachers should be trained to deliver ERE or online teaching and learning in general. The full extent of the effects of teaching and learning during Covid-19 are not yet fully understood, assessments have had to be adapted for online learning and changes to the curriculum may be necessary in the future however, this will be a slow process. This study has reiterated the need for learning to be reformed and for technology to be embedded in teaching and learning (SOLAS, 2020) successfully. Educators should focus on delivering an enhanced learning experience and quality education through online learning and take the necessary steps to improve their pedagogy in this area. This study has contributed to the knowledge of this area and provided many opportunities for further research which will be discussed in the Recommendations and Implications section of this chapter.

5.3 Recommendations and Implications

Having completed this research study, the implications, and recommendations for future practice along with opportunities for future research in this area have been identified. This research is topical and has significant implications in the current context as it has been a new experience for both learners and teachers. The suggestions for future practice in online teaching and learning pertain to enhancing the overall learning experience for learners and improving teaching and gaining new knowledge in this area.

There are various implications of this research, the findings of this study have allowed for a unique insight into the lived experience of S&T students in FE engaging with online learning and ERE during a worldwide pandemic. This study has provided key information relating to the barriers and facilitators of ERE in this context and created an opportunity for further research in this area. As the concept of online learning is new in FE, this research has highlighted the areas of online learning in STEM subjects that can be improved and afforded teachers the opportunity to improve their pedagogical excellence in this area and enhance the teaching and learning experience.

Throughout this study, it was evident in this context that teachers were not trained in delivering ERE, as this was unprecedented. Within this context, the study highlighted the need for teachers to be trained in delivering online learning and in the use of various digital platforms to enhance learner engagement. To combat the skills deficit in STEM subjects that was created due to online learning, simulation software packages such as virtual reality platforms i.e., Experizer or Labster: The Complete Guide to Virtual Labs, could be used in the teaching of practical skills.

Some of these suggestions involve a large level of teacher training and an investment in software packages which can be time consuming and costly for FE Institutions. As previously stated, the findings of this study are only representative of a particular context. The implications of this study may not be comparable across different FE institutions as some FE institutions may already have in place these recommendations. This study has however highlighted that effective planning of

online teaching and learning will be key in the delivery of future FE courses. A significant implication of this research is that it provides a focus for future research investigating the student experience of online learning in FE, particularly within STEM subjects. The findings and implications of this study may have wide transferable benefit or small transferability however, more research needs to be conducted in FE environments to investigate this further.

5.3.1 Opportunities for future research

Future trends in FE include blended learning and the increased use of technology (SOLAS, 2020), due to ERE the scope for online/blended learning in FE has now been provided but there is a need to improve pedagogy in this area. It is also necessary for further studies in online learning to be conducted outside of a worldwide pandemic as there may be differences related to the lived experience that may be applicable to a wider context.

Future research investigating the lived experience of S&T students engaging with online learning should include more participants to gain a wider perspective, should focus on a more in-depth data analysis where interviews can be repeated to extract a deeper insight and should investigate the use of different software to learn key practical skills, rendering the value and effectiveness of each. Further studies in this area could also conduct a mixed methods research approach to investigate how digital competency levels change throughout the duration of an online course and to understand the impact that digital competency has on a learner's educational experience in online learning. As the findings of this study are representative of a particular cohort, a similar study could be conducted in the wider area of FE courses to provide as much detail as possible about the lived experience of students who engage in online learning to improve knowledge in this area.

The unexpected findings of this study should also be further explored, a research study exploring self-regulated learning strategies, motivation and empowerment in online learning could be conducted. A final suggestion for future research pertains to investigating teacher perception of

online teaching and learning, exploring levels of confidence and competence in the use of digital technology. The findings of this future study along with the findings of this current study discussed could provide a holistic view of both teachers and learners perception and experience of online learning in S&T courses in FE creating the opportunity for an overall enhanced teaching and learning experience to be created and implemented. As stated previously, the concept of online and blended learning in FE is a new concept and will need to be further explored to ensure it is successful implementation.

5.4 Personal Reflection

For me personally, conducting this research has been an eye-opening experience for which I am grateful for, I had conducted previous research for my undergraduate degree in science but not to the same extent. This research was a phenomenological study which I was not familiar with and encouraged me to explore and understand the philosophy of phenomenology to truly appreciate its value in this context. This research has encouraged my own critical reflection as a teacher in FE and I hope this research will also enhance the knowledge of my colleagues and other teachers in FE about the lived experience of students in S&T courses who engage with online learning. In my opinion, it is important to understand this to improve pedagogy in this emerging area and I feel this research is significant and meaningful for this reason.

Throughout this research, I learnt a lot about myself as a researcher. I initially was not well versed in interview techniques, but this research has afforded me the opportunity to improve my proficiency in this area. I also now appreciate the importance of time in conducting meaningful research, this process has helped me to develop key research and time management skills. Conducting this research has been a challenging process but I am very pleased with the overall dissertation. I have gained substantial information about this phenomenon that will assist me in improving my pedagogy and achieving one of my core values as a teacher to ensure all learners are provided with equal learning opportunities. I also learned pertinent lessons about conducting

research in social science, specifically education which I will consider and apply if I am presented with the opportunity to conduct research in the future. Overall, I hope the adaptations made during Covid-19 for online teaching and learning will lead to a lasting positive change in education and enhance the overall quality of education.

5.5 Summary of Chapter

This chapter has outlined the overall conclusion of the dissertation summarising the findings of the study. This chapter has also discussed the implications of this research, recommendations for improving online pedagogy in STEM subjects and outlined opportunities for further research in this area. This research has concluded with a personal reflection of this research process and my research journey. This research study has achieved the aims and objectives set out and understood the lived experience of four S&T students in FE engaging with online learning during Covid-19 and the impact of this on the learning experience. This research will pave the way for future research in this area and provide knowledge and understanding to the wider FE community to improve online teaching and learning.

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Appendices

Appendix A: Advanced Information Sheet

Research Project Information Sheet

You are invited to participate in a research study.

My name is Laura Cullen and I am a student of the MA in Educational Practice programme at National College of Ireland (NCI).

I am undertaking research on ***"the student experience of online learning in Science and Technology courses in Further Education".*** As part of this research I wish to interview students of Science and Technology courses to understand their online learning experience.

Participation in this research is voluntary. If you wish to participate in this research, I will invite you to take part in a short interview with me online via MS Teams. This interview will take approximately 30 minutes – 1 hour and will be audio/video recorded. This interview will focus on your experience of online learning.

Please rest assured that your participation in this research will remain anonymous throughout the research process. The findings of this research will be published to NCI as part of my dissertation. In the case of further publication of this research, your anonymity will remain.

To participate in this research, you will need to complete the attached consent form and email it to the below email address.

If you have any questions about the research that I can help you with, please feel free to contact me.

Email address: x19111088@student.ncirl.ie

Laura Cullen

Appendix B: Participant Consent Form

Participant Consent Form

I Laura Cullen, a student of the MA in Educational Practice programme at National College of Ireland (NCI), am conducting research into the student experience of online learning in Science and Technology subjects in Further Education as part of my dissertation.

You have volunteered to participate in the above research. Please complete the below form to consent to participating in the research study.

I_____ (PRINT NAME) consent to participating in the above named research. The name of the Further Education Science and Technology course I am currently undertaking is: _____

In consenting to participating in this research study, I am saying that:

- I understand what the research is about.
- I understand the purpose of the research.
- I understand that my participation in this study is completely voluntary.
- I am happy that any questions I had about the research study have been answered.
- I agree to participate in an online interview focusing on my experience of online learning that will be audio/video recorded.
- I understand that I do not have to answer any questions that I do not want to.
- I understand that any information I provide will be stored securely and will only be used for the purposes of this research study.
- I understand that in participating in this research, I am consenting to information I provide being published in an unidentifiable manner as part of these research findings.
- I am aware that I have the right to withdraw my participation from this study at any time before the study is completed and that this means any information I have provided throughout the study will also be withdrawn from the findings of this research.

Please state any further comment that you may have: _____

_____

Signed: _____ Date: _____

Appendix C: Additional Research Information Sheet

Additional Information for Research Project

Thank you for your interest in participating in my research on "the student experience of online learning in Science and Technology courses in Further Education" and completing and returning the initial research consent form.

You have now been allocated a time for interview for this research.

Before your interview can you please confirm the below statements to be true:

- I have read the research project information sheet
- I am over 18 years of age
- I consent to the interview being video and audio recorded
- I understand that the findings of this study will be submitted to National College of Ireland as part of a Dissertation project and that the findings may be shared with the host Institution of Further Education.

Signed: _____

Date: _____

Please return this completed form to me via email before your interview.

If you have any questions, please do not hesitate to contact me.

Thank you,

Laura Cullen.

Appendix D: Interview Schedule

Name: Laura Cullen

Research area: The student experience of online learning in Science and Technology courses in Further Education

Interview Schedule

- Inform participant interview is being audio and video recorded
- Confirm understanding of the research project and consent to video and audio recording of interview with participant
- Inform participant the interview will be transcribed and that a copy of the transcription will be available upon request.

Experience

1. Can you please state the name of the course you are currently studying and list the modules of this course? Please tell me about a typical day of online classes in this course. How many hours do you spend online for classes per day approximately? Do you attend the college for any face-to-face classes?

2. Tell me about your expectations of online learning? Had you participated in online learning prior to this course?

Digital Literacy

3. How comfortable are you with the use of computers? Has your computer literacy level changed throughout the course?

Cognitive Presence

4. Can you tell me about the aspects that you like about online learning and why? Additionally, can you tell me about aspects of online learning that you dislike, and why?

5. Which teaching methods do you find effective and why?

6. Which online learning platform do you access course content from? Do you find it easy to access the course content online? Do you perceive this content to be adequate for your learning within this course, why or why not?

Teaching Presence

7. In your opinion, what impact do teachers have on the online learning in your course? How do you feel about the level of interaction with teachers in your course? When do these interactions occur and how often? Do you feel you are provided with clear instructions and enough support from your teachers to excel in this course?

Social Presence

8. How often do you interact with other students in your course? What is the method of this interaction? Are these interactions beneficial?

Challenges

9. Have you encountered any challenges within the course through online learning? Is there anything you missed about the in-class learning environment? Overall, comparing online learning with face-to-face classroom learning what do you think is lost/gained?

Overall Experience

10. How would you describe your overall experience of online learning? Is there any advice you may give to future students for undertaking online learning in this course? Or considerations for your own future within online learning? Can you describe what you think the ideal online course delivery process would be like?

11. Would you prefer to do future courses solely online, have an element of blended learning where you're in the classroom and online or fully face to face in in the classroom?

Anything to add?

Thank you.