Change in the Learning Habits of Higher Education Students in Oman with Increasing Ubiquity of Technologies such as Wireless Networking and Mobile Devices

Kishori Balliammanda, BSC, MA, PGCTE

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Department of Educational Research
Lancaster University
UK

Abstract

This research study investigates a student-centred constructivist model to limit the role of a physical teacher and help students to learn online. The study was conducted to ascertain how Omani students and teaching staff have adapted and related over a period of two years to technologically-driven pedagogical changes to leverage maximisation of the benefits of online learning, facilitated by the inclusion of technological systems for teachers and students alike. This study is designed to facilitate pedagogical change via the input of technology within the learning environment as a means to provide a more efficient and flexible way to deliver learning to Omani students. Essentially, this study looks at whether it is possible to move away from a teacher-centred philosophy to a mindset that embraces a joint teacher/student-centred initiative. The quantitative and qualitative forms of data were processed via a two-pronged qualitative thematic analysis to evaluate and understand participants' responses. Additionally, quantitative statistical analysis using a 5-point Likert scale of 63 structured questionnaire responses was used to inform the study outcomes. The data analysis used the repeated measures analysis of variances (ANOVA) and post-hoc evaluations to ascertain the difference between teachers' and students' perceptions over two periods to ensure that an assumption of sphericity was addressed within the distribution of data for the repeated measures ANOVA tests. The findings indicate that the views of interviewed stakeholders showed progressive adaptation to pedagogical changes by both students and staff and offer a contribution to existing studies through valid solutions to address both teacher and student areas of concern in Oman. The findings of this study can be used to benefit the Omani education system and future researchers. Finally, the findings are made available to all members of the Omani society for beneficial action and to further improve the outlook for both teachers and students in Oman.

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Acknowledgements

At the beginning of my doctorate journey years ago, I did not anticipate all the twists and turns that I would encounter and address every morning when I awoke and ruminated about before falling asleep at night. In addition to numerous challenges, there were some bright spots throughout this complex and intricate PhD doctoral journey.

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Dedication

I dedicate this doctoral thesis to all my students in Oman, past and present, who seek to contribute to our health in this world. As faculty and stakeholders of the youth living in Oman, we have a responsibility to enable emerging generations to discover new horizons within our land of opportunity and continue to research new untapped reservoirs of knowledge thereby expanding understanding and wisdom for all of humanity. I dedicate this thesis to all those who endeavor to help students in Oman in their quest to exploit and leverage the benefits of technology to deliver a student-centred learning process in Oman. Finally, I dedicate the findings in this doctoral thesis to be used to inform and support all those who genuinely care for the educational system in Oman.

Author's declaration:

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Kishori Balliammanda, BSC, MA, PGCTE

This thesis results entirely from my own work and has not been offered previously for any other degree or diploma. The word length 42348 of this thesis conforms to the permitted maximum

Signature

Kishori Balliammanda, BSC, MA, PGCTE

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CHAPTER ONE

INTRODUCTION

1.1 Research background

The idea of non-conventional education or learning outside a conventional classroom was long mooted as far back as the 1800s, with the introduction of correspondence schools in the United Kingdom (Kentnor, 2015). Distance or online learning was formally introduced into the higher education system in the United States of America in 1982 with the major aim to deliver a distance education programme to business executives outside of the campus setting (Rowan & Feenberg, 1983). The many inventions, developments, and incremental advancements in the field of Information and Communications Technology (ICT) has resulted in the development of a wide range of uses other than just information processing and transmission; such wider uses can involve numerous communication devices (including software programs, data projectors, interactive teaching box, and office machines) now used by many students and teachers within the academic environment.

1.1.1 Higher Education in Oman and the Middle East

In the Arab world, specifically in the Middle East, the need to move along with the rest of the world in the field of education and technological advancement has become of utmost necessity if the region is to remain focused and up-to-date in global contemporary development events. Higher education in Oman and the Middle East has progressed significantly over the past few decades. In the past, there were limited options for higher education in the Sultanate of Oman, with only a few universities and colleges available. However, today, Oman, like most Middle Eastern countries, boasts a robust higher education system with a range of academic institutions offering a broad array of academic programmes (Al-Senaidi, Lin, & Poirot, 2009).

In Oman, the regulation of the higher education sector is the responsibility of the Ministry of Higher Education, Research, and Innovation (MoHERI). The Ministry promotes the establishment and development of higher educational institutions in the country through several initiatives. One of the significant initiatives launched by MoHERI is the Oman Academic Accreditation Authority (OAAA) established on August 1st, 2019. This body is responsible for accrediting universities and colleges in Oman, which helps to maintain high academic standards in the country. The OAAA also established a framework for academic programmes to ensure that they are relevant and up-to-date, and meet international standards. In addition, the Ministry has invested heavily in the country's universities and colleges to ensure that they have state-of-the-art facilities and equipment (Mininistry of Higher Education in Oman, 2023).

Today, the Sultanate of Oman has more than 30 academic institutions, including universities, colleges, and research institutes. The first university established in Oman was the Sultan Qaboos University which came on board in 1986. However, in 1984 and before the coming of Sultan Qaboos University, Higher Technology Colleges were established in various places across the country such as Muscat, Salalah, Nizwa, Suhar, Al Musannah, Shimas, Ibri, Ibra, Rustaq, Sur, and Khasab. These colleges of technologies were merged at the end of 2019 to form what is now known as the University of Technology and Applied Sciences. In recent years, several new universities have also been established, including the University of Buraimi and specialised medical colleges. These institutions offer a broad range of programmes at the undergraduate, postgraduate, and doctoral levels, in areas such as engineering, medicine, law, business, and humanities (UTAS, 2023).

1.1.2 The demand for higher education and the challenge of growth and change in Oman

Buoyed by the need to increase development of human capacity through learning, higher education in Oman was made not only accessible but also affordable (Al-Shboul & Alsmadi, 2015). The government implemented several learning enhancement and scholarship programmes for students, including increasing the number of student enrolments in the country and, in addition, offering overseas scholarships for postgraduate studies. Within a period of four years, university and higher educational admissions and enrolment doubled. This resulted in the increase in admission of Omani students into higher institutions from 29,593 in 2016 to over 60,000 in the year 2020, while students' enrolment rose from 116,677 in 2016 to 227,056 in the year 2020, thus, recording an increase of over 95% in four years (National Centre for Statistics and Information, 2023).

Oman's higher education system has no doubt contributed to the country's socioeconomic development. The growth of the higher education sector has helped to create new job opportunities, particularly in the areas of research and education (Al-Shboul & Alsmadi, 2015). The country's universities and research institutes have also promoted innovation and entrepreneurship, leading to the creation of new businesses and industries. However, owing to the low level of manpower development and the additional costs involved in hiring expatriates, it becomes imperative to develop home-grown human resource capacities in a very short period (Al-Shboul & Alsmadi, 2015). This was responsible for the rapid increase in the establishment of higher institutions of learning with the attendant increase in students' enrolment. Given a larger than normal staff/student ratio averaging between 1:30 and 1:60 in some extreme cases, there arises a need to augment classroom teaching with home-based alternatives such as online options

in order to depopulate over-crowded classrooms (El-Masri & Tarhini, 2017). In addition, the Covid-19 pandemic buttressed this need when a regime of less body contact was globally implemented to curtail or stop the spread of the pandemic through classroom contact (Qi & Meng, 2022).

The concept of flexible online learning was developed and motivated out of the necessity to keep up with emerging global realities in terms of technological advancements and to minimise the effects or dangers associated with natural emergencies and phenomena, as opposed to just meeting the demands posed by articulated need (El Alfy, Gomez, & Ivanov, 2017). The integration of technology in classroom teaching has become a global initiative borne out of the need to design and develop pedagogy and learning in education as more flexible, affordable, and less stressful to learners and teachers (El Alfy et al., 2017). In addition, the need to take advantage of new technologies in education and to minimise the risk of contracting infections during pandemics has also influenced the thinking and strategic planning of those tasked to promote the delivery of online education (Tarhini, Scott, Sharma, & Abbasi, 2015).

1.1.3 Technology and teaching in Omani higher education

The introduction of technology in higher education teaching and learning has been on the rise in the Middle East in recent years (Al-Shboul & Alsmadi, 2015). The development is driven by the desire to enhance student engagement and learning outcomes and to keep up with recent changes and developments in global education systems and styles. With the rapid advancement of technology, universities and colleges in the region have been quick to adopt to various types of technology to improve students' learning experiences. Jordanian universities were among some of the higher institutions in the Middle East to adopt technology in teaching at an early time (Al-Shboul & Alsmadi, 2015).

In Oman and the Middle East, the types of technology in current use include learning management systems, which provide a platform for students to access course materials, submit assignments, and interact with fellow students and teachers. Virtual classrooms have also gained popularity, enabling students to participate in live classes and discussions from anywhere in the world. Online libraries provide teachers and students with access to a vast array of academic resources, including journals, e-books, and research papers. In addition, there are educational apps that help students learn on the go, such as language learning and educational games apps (Al-Hinai & Al-Shihi, 2018).

The story of higher education in Oman cannot be complete without the mention of the Oman Ministry of Higher Education, Research, and Innovation's (MOHERI) provision of software programs, data projectors, and interactive teaching box, which is also charged with the responsibility for approving the establishment of new schools, regulating the running of the existing ones, guiding, approving, and accrediting new and existing higher education curricula and academic programmes. The Ministry is also empowered to licence and de-licence schools in accordance with its operational guidelines. The Ministry's website stipulates that student admission selection into any university must be based on a student's performance in High School Final Examinations as may be permitted by the school's approved enrolment capacity (Ministry of Higher Education in Oman, 2023). Most of the Omani higher education institutions commenced postgraduate programmes in the year 2018.

As of December 2020, the total students' enrolment for all registered higher education institutions in Oman stood at 227,056 of which 44% were male and 56% female. This represents a 94.6% increase in enrolment from the 2016 figure of 116,677. This jump in enrolment can be rightly attributed to a radical reform in the higher education Ministry in the year 2018 which merged all the eleven Higher Colleges of Technology in

various campuses into a university and allowed many schools to commence postgraduate programmes covering advanced diplomas, masters, and doctoral degree programmes (Ministry of Higher Education in Oman, 2023).

The integration of technology in Omani higher education has undoubtedly transformed the way students can learn and interact with their teachers. The various types of technology in use have made education more accessible, convenient, and engaging. Specifically, the most used learning technology apps include Kahoot, Duolingo, Quizlet, Edmodo, Google Classroom, Rosetta Stone, Coursera, Code.org, Mathway, and Memrise (Ministry of Higher Education in Oman, 2023). As technology continues to advance, it is expected that more innovative solutions will emerge, but it remains to be determined whether these technology-based innovations in higher education in Oman and the Middle East will translate to better learning outcomes and improvement in the education landscape in the region (Al-Zadjali, Al-Kalbani, & Al-Mahrooqi, 2019).

Online learning and distance education have been substantially developed and are gradually gaining prominence in the developed world, primarily due to the ease and flexibility they offer to indigent students who might not easily be able to afford the financial cost and timing requirements of on-campus classroom learning programmes (Kentnor, 2015). Moreover, Oman and other developing Middle Eastern nations were still coming to terms with the concept of leveraging technology-based online learning when the restrictions imposed by the emergence of the Covid-19 pandemic forced the implementation of online learning onto educational institutions globally (Tarhini et al., 2015). It may become a case of compliance with the new realities of remote learning via sophisticated technology.

The introduction of a technology enhanced learning system in Oman obviously requires a basic knowledge of the tools needed to advance the working and continuity of

a technology-based education system. Technology-based education also requires an understanding of how the proposed learning system is acceptable, integrative, and compliant with the existing system in satisfying the objectives for which the existing classroom-based education system was created to satisfy, such as addressing any problems which the former system was meant to address or was unable to address adequately. Many research studies such as those of A-Shboul and Asmadi (2015), Al-Zadjali, Al-Kalbani, and Al-Mahrooqi (2019), Al-Hinai and Al-Shihi (2018), Al-Harthi and El-Masri and Tarhini (2017), have been carried out in the Middle East to gauge the acceptance and conformity of students and teachers with the concept and operational functionality of online education. Such functionality of this type could be seen in the ability of teachers to deliver learning for students via platforms such as Zoom and Microsoft (MS) Teams when teachers cannot be physically present or when students are unable to attend the physical classroom setting (El-Masri & Tarhini, 2017).

All of the cited studies on the integration of technology in teaching, to some extent, have indicated the existence of some useful and compelling findings which have, one way or another, served to influence the decision-making process of both local governmental bodies and educational institutions. The findings from the various studies on the need for technology integration have served to promote and develop online and technology-based learning in Oman and the Middle East (El-Masri & Tarhini, 2017; El Alfy et al., 2017; Tarhini et al., 2015).

1.2 Problem statement

A common theme in the Middle Eastern literature pertaining to online learning concerns the prime importance of tutors taking a leading role when introducing technologies such as virtual learning environments (VLEs) or research portals (El Alfy, Gomez, & Ivanov, 2017). For the vast majority of students in the Middle East, their

learning habits can be understood through looking at the literature, such as El Alfy, Gomez and Ivanov (2017), pertaining to how their tutors approach teaching. However, there are exceptions which hinder the online delivery of some subjects, most notably in engineering and medicine, as these subjects may only be taught within a physical setting. In terms of overreaching topics of the Omani and United Arab Emirates (UAE) literature, discussions of learning habits are often focused too narrowly on approaches to assessment (El Alfy et al., 2017); the literature on study skills and use of library resources is also useful for looking at how students are studying rather than just how they are preparing for tests and assignments (El-Masri & Tarhini, 2017). This includes examples of students going beyond those e-learning opportunities provided by their university, such as using social media or alternative research repositories (El Alfy et al., 2017).

While the existing studies on online education or e-learning in the Middle East have focused more on how an individual responds to changes and the role of teachers in shaping pedagogical innovations, the aspect of communal, trade groups, and professional associations' responses have seemed somewhat ignored in these studies. While El Alfy et al. (2017) located their exploratory quantitative study within the framework of technological readiness in a UAE university, a study was yet to be conducted on how the individual tools and devices for online learning influenced the acceptance or otherwise of the concept. Moreover, while Ajzen and Fishbein (1980) used the theory of reasoned action in management theory to explain how individuals responded to change, Conner and Armitage (1998) employed the theory of planned behaviour as a method to achieve the same levels of change (Ajzen & Fishbein, 1980; Conner & Armitage, 1998). The problem with these two studies is that they are too focused on how an individual responds to change, as juxtaposed to the work of Trowler (1998), which considered the professional identity of an individual. The studies of Ajzen and Fishbein (1980) and Conner and

Armitage (1998) failed to factor in or provide a sufficient account of the particular ways in which academics respond to change (Trowler, 1998).

Based on this rationale and way of thinking, it is useful to consider the findings of the study by El Alfy et al. (2017), not just in terms of e-learning maturity, but also in terms of other concepts such as communities of practice (Wenger, 1998), as a means to understand their results with regards to ways that may have led to pedagogical change (Wenger, 1998). In addition, while other studies such as El-Masri and Tarhini (2017) and Tarhini et al. (2015) considered only the attitudes and efforts of teachers in driving pedagogical change in the Middle East, this created a gap which aroused the interest and possibility that a joint students'/teachers' perceptions study might create and develop more helpful and relevant findings. The research studies on the prospects and problems of integrating technology by authors such as Trowler (1998), Wenger (1998), Tarhini et al. (2015), and El Alfy et al. (2017) could be utilised to position and develop the concept and execution of online, e-learning or technology-based education more productively and effectively for Omani students.

1.3 Purpose of the research

This research study was conducted to investigate the effects of the introduction of online or technology-based learning in the Omani institutions of higher learning on pedagogical development and students' academic performances. It was also conducted to evaluate the level of acceptability of the concept, the preparedness of both teachers and students to adapt to the change, and the growth in the implementation (if any) of the concept. In addition, it was conducted to determine the readiness of the universities and the government regulatory authorities in supporting the concept, and the general perceptions of the teachers and students involved in the programme on its potential viability or possible negative outcomes. Based on my personal motivation to conduct this

study, over the period of time I have lived and worked in Oman, some of my peers have expressed their concerns about the need to improve the delivery of teaching and learning using online systems and platforms, and better teaching mechanisms.

1.4 Significance of the study

This research study was conducted to investigate the perceptions of both students and teachers pertaining to the integration of technology in learning within Omani higher institutions of learning. Previous studies in the Middle East region were narrowed to teachers' influences on the development of pedagogy, individual students' responses, and the technological readiness of the institutions. But there is a need to close the gap created in previous studies in which they ignored the joint students'/teachers' perceptions. This study is particularly significant because:

i) It focuses on both teachers' and students' perceptions on the gains and desirability of online or technology-based learning rather than on only teachers' perceptions.

ii) It measures the periodic differentials in respondents' perceptions of the gains of integrating technology with learning.

iii) It introduces and infuses a sense of joint ownership of the change in educational pedagogy in both students and teachers.

iv) It engenders enlightenment on the needs and expectations of students, teachers, and their institutions as regards the resources and infrastructure required for a sustainable technology-based learning and online education.

v) It delineates the devices necessary and mostly employed in the execution of technology-based learning and charts a path for future studies in the same area.

1.5 Immediate context and research motivation

This study is motivated by the need to investigate and document the benefits, potentialities, possibilities, and new opportunities inherent in online and other non-conventional technology-based distance learning systems. Most of the earlier studies on the introduction of technology into teaching such as Trowler (1998), Wenger (1998), Tarhini et al. (2015), and El Alfy et al. (2017) were notably carried out outside the Sultanate of Oman and were mostly anchored on the adoption, adaptation, and teachers' responses on the development of technology-based pedagogy. Little or no mention was made of teachers' and students' perceptions on the gains and desirability of online or technology-based learning especially in the Sultanate of Oman.

It is particularly important to situate a study like this within the confines and context of the Sultanate of Oman because, though the Omani people are predominantly Arabs, cultural and attitudinal differences stemming from the country's mode of governance tend to differentiate them from the rest of the Middle East. The Omani people, for instance, practice a form of Islam known as Ibadism, which is a moderate and more tolerant form of Islam that emphasises individual responsibility and community harmony, distinct from other countries in the region. The Omanis are mostly seafarers, and this has impacted deeply in their culture and economic way of life (Britannica, 2023).

The justification or motivation for this research stems from the general need to inform and enlighten governmental bodies, school authorities and academic institutions, and the discerning public of the need to put the joint students' and teachers' perspective both as individuals and as a community of respondents into account while deciding and implementing technology-based education curricula. While many potential students have had reasons to question the authenticity, acceptability, standardisation, and usefulness of the course contents and course delivery methods of non-conventional classroom learning

programmes in the past, there is an urgent imperative to dispel the fears or biases that could be inherent in these instances. This can be achieved through research studies which are designed to probe into the foundations of the design and implementation of online and technology-based off-campus programmes.

Non-conventional learning and online education, as presently provided in the Middle East, operates under many variables which have countered against the ideals of their existence and might even adversely affect their sustainability if these variables are not well articulated and explained. Such variables as culture and language have been found by some studies to constitute small barriers and counter the full realisation of the potential benefits of online and technology-based learning (Al-Senaidi, Lin, & Poirot, 2009).

1.6 The larger context

This research study was further motivated by the need to highlight the benefits and practicability of online and technology-based learning as a complement to conventional in-campus classroom learning which has the potential capacity to deliver the same knowledge base and course contents as the academic education delivered in the conventional classroom. In addition, and as previously stated, pedagogy is being envisaged with the need to transit from teacher-centred transmission models of education to more student-centred, constructivist models which requires positioning pedagogy as an outcome of students' articulated learning preferences reflective in both style and delivery mode (Al-Senaidi, Lin, & Poirot, 2009). A student-centred constructivist model expects curriculum developers to consider learning in a much broader sense, which might include requiring less involvement of teachers in learning, and for learning to be delivered into locations and settings dictated more via the enactment of students' choices and personal preferences.

Furthermore, previous research studies such as Al-Senaidi, Lin and Poirot (2009) concerning the effects or acceptability of online and technology integration in learning used more of a singular approach through either a qualitative-focused primary investigation or a quantitative-based empirical inquiry. These approaches centred more around theories of educational change from a teacher-centred perspective without due consideration of the students who are the recipients of the teacher-derived learning outcomes. One research study explained that a teacher-centred learning approach in pedagogical development is a "theoretical stance away from the constricting nature of the standards, accountability and performance management agenda which is known as a poststructuralist approach" (Kennedy, 2005, p.245).

Given (2008) claimed that a methodological design from a poststructuralist theoretical framework is informed by "concepts of relativity, plurality, fragmentation, and anti-foundational construction" (Given, 2008, p.666). My research study deviated substantially from the previous singular approaches by combining the evaluations of the perceptions of both teachers and students together using qualitative and quantitative measurements (as mixed methods research) as a joint methodology to arrive at a middle point or negotiated medium between a teacher-centred poststructuralist approach and a student-centred constructivist model in effecting mutually acceptable changes in pedagogy initiated through the integration of technology in learning.

1.7 Research questions

This research study was designed and guided by the need to resolve the following research questions:

What forms of technology do the students use for learning inside/outside the classroom and for social interaction in Omani and how has this usage changed since technology first

started to be used as a teaching tool in Oman in 2001, and particularly between 2019 and 2021?

Do teachers use different forms of technology for different purposes? How does this impact on teaching and learning in higher education (HE)? To what extent have teachers embraced the changes in technology since it was first introduced in Oman in 2001, and particularly between 2019 and 2021?

What are the perceptions of Omani higher education (HE) students and teachers pertaining to using technology for learning and teaching inside and outside the classroom? How have changes in technology, for example mobile devices or e-learning, impacted these perceptions?

1.8 Research hypotheses

To enable a thorough resolution and complete quantitative comprehensive understanding of the study research questions presented earlier, the study formulated the following hypotheses:

H_0 – 1: There is no significant difference in students' perceptions of changes in technology affecting learning and pedagogy in Omani higher educational institutions between 2019 and 2021.

H_1 – 1: There is a significant difference in students' perceptions of changes in technology affecting learning and pedagogy in Omani higher educational institutions between 2019 and 2021.

H_0 – 2: There is no significant difference in teachers' perceptions and acceptance of changes in technology affecting learning and pedagogy in Omani higher educational institutions between 2019 and 2021.

H_1 – 2: There is a significant difference in teachers' perceptions and acceptance of changes in technology affecting learning and pedagogy in Omani higher educational institutions between 2019 and 2021.

1.9 Overview of the thesis

This research study is constructed as a six-chapter thesis with appendices for tables and other resources utilised in the development of this study. The summarised details of the thesis are given in the subsections following.

1.9.1 Preliminary pages

The preliminary pages to this thesis consist of the title, acknowledgement, and the abstract pages. They contain information introducing the authorship, essence, legitimacy, and origin of this thesis.

1.9.2 The body of the thesis

The body of this thesis consists of the introductory chapter (Chapter One), the literature review and theoretical perspective chapter (Chapter Two), the methodology and methods including ethical considerations chapter (Chapter Three), the results or findings chapter (Chapter Four), the discussion chapter (Chapter Five), the conclusions and further research chapter (Chapter Six), and sections for references and appendices.

Chapter One embodies the background and reasons for the research, which specified the problem of study, with the significance and justification for the study that hinged around the need to close the research gap that was not addressed by previous studies concerning online and technology-based learning in institutions of higher education in the Middle East and more specifically in Oman. Also included in this chapter are the research questions and study hypotheses which guided the execution of this research study.

Chapter Two deals with the review of the concepts and theories surrounding and/or supporting online and non-conventional learning and the issues they faced as applicable to Oman and other Middle Eastern countries. Chapter Three details the methodology adopted in the planning and execution of the thesis, giving reasons and instances from previous supporting studies on why the mixed methods approach was adopted. This chapter is followed by Chapter Four and Chapter Five which are used to present and discuss the results of the data analyses, comparatively, in line with the research questions and findings from similar research studies. These two chapters draw attention to the main thrusts of the motivation behind the conceptualisation of the research investigations conducted with this study.

Chapter Six utilises the findings, discussions and the literature reviewed in previous chapters to draw meaningful conclusions and made recommendations pertaining to the implications of the findings to relevant stakeholders in the education sector, particularly regarding those governments and authorities tasked with the jurisdiction of managing higher educational institutions. Chapter Six also contains the noted contributions of this research study to the body of existing knowledge while recommendations are made in the same chapter for further research studies on areas not covered by this and other research studies which might help to position online learning and integration of technology in distance education into a prominent and more viable reality in the future of Oman and in the Middle East.

CHAPTER TWO

LITERATURE REVIEW

2.1 Structure

According to the historian Hart, a literature review should emerge from specific highly-relevant papers in order to encompass a broader context which makes sense of those papers and, by virtue of their close relevance, the study being proposed (Hart, 2018). In this way, specific studies are located within a broader theoretical framework and can therefore be understood as a whole rather than in isolation. The search for the literature review for this study started with the Education Research Complete database using a range of keywords - e-learning, blended learning, digital learning, online learning and MOOC. In each case, results were filtered to consider only those papers which covered the earlier indicated keyword as applicable to Oman, the Middle East and some few western countries. These results were all imported into Mendeley so that a total of 62 papers could be considered in greater detail. Theoretical frameworks mentioned in the papers were noted and inspired further reading of theoretical and seminal works, which are used in the following section to provide an outline structure and relate the literature within the broader frameworks of pedagogical and technological change employed in this study within a wider international context.

The pace of technological change requires the latest research be used, so in keeping with the research questions, particular emphasis was given to articles within the last few years on the basis that they would reflect the most recent two years of innovation at the time of data collection, the period that my study focuses on. For the same reason, conference proceedings were also included, even though their peer review standards can be less rigorous than for journal articles.

Omani and UAE research often uses a wider international theoretical framework for their studies. For example, it can be seen how an exploratory quantitative study looking at technological readiness in a UAE university (El Alfy, Gómez, & Ivanov, 2017) locates itself within the framework of technological readiness. However, while the study contextualises this within management theories such as the theory of reasoned action (Ajzen & Fishbein, 1980) or the theory of planned behaviour (Conner & Armitage, 1998), such theories are arguably too individualistic – the theories are too focused on how an individual responds to change as juxtaposed to Trowler's work which considers the professional identity of an individual, and they do not take sufficient account of the particular ways in which academics respond to change (e.g. as in Trowler, 1998). It is therefore useful to consider the findings of the study by El Alfy and colleagues not just in terms of e-learning maturity but also in terms of other concepts such as communities of practice (Wenger, 1998) to understand their results with regards to ways that may have led to pedagogical change.

Similarly, a common theme in the Middle Eastern literature is the prime importance of tutors taking a leading role when introducing technologies such as virtual learning environments (VLEs) or research portals (El-Masri & Tarhini, 2017; Tarhini, Scott, Sharma, & Abbasi, 2015). For the vast majority of students in the Middle Eastern context, their learning habits are therefore better understood through looking at the literature on how their tutors approach teaching. However, there are exceptions by subject area, most notably in engineering and medicine, which provide a more thorough understanding of how students conceptualise their current and future needs. Finally, in terms of overarching topics of the Omani and UAE literature, discussion of learning habits are often focused too narrowly on approaches to assessment (Boud & Falchikov, 2006; Race, 2015), so the literature on study skills and use of library resources is also

useful for looking at how students are studying rather than just how they are preparing for tests or assignments. This includes examples of students going beyond those e-learning opportunities provided by their university, such as using social media or alternative research repositories.

The scope of this literature review is directed at looking at the benefits of technology enhanced forms of learning in the Middle Eastern country, Oman. From my experience, I argue that this is a country in which education is increasingly adopting digital technologies as a way to improve teaching and learning techniques and practices. Moreover, I adopt this scope for other reasons, as I can reflect not only on the unique characteristics of the Middle Eastern context of education and learning, but also on abilities to adopt and generate technology-enhanced learning (TEL).

This region's socio-economic development is rapid, as there is a growing interest to include e-learning, blended learning, and other digital learning systems. The literature review provides an understanding of how TEL and other technologies are understood, based on specific cultural, linguistic, and socio-political contexts. My study seeks to generate broader concerns, to foster diversity and inclusivity in educational research. So, while TEL and related research originates from Western contexts, there is an evolving awareness to examine non-Western region perspectives. Miles et al. (2021) support this approach by examining TEL in the MENA region. My study seeks to enrich the debate pertaining to TEL as a means to inform future research and practice in both regional and global educational contexts.

I considered other possible alternative scopes to TEL, such as conducting an analysis across multiple Middle Eastern countries as opposed to just an analysis in Oman. While this broader approach may shed light on regional trends within the Middle East, I rejected this alternative due to the likelihood that depth (subjectivity and specificity)

would be sacrificed for breadth (general trends) thereby sacrificing the inclusion of specific contextual factors that influence TEL in Oman. Moreover, this broader approach would have placed a significantly greater demand on time and resources.

Finally, this alternative was rejected so that I could focus on Oman's unique socio-economic and cultural characteristics as opposed to gaining a more general regional picture that would not be directly applicable to Oman's own unique educational system.

2.2 Valuing of e-learning

Being cognisant of, and appreciating value in, a resource are crucial initial steps for students to use those resources in study, and deliberation in the Middle East has emphasised how this can be a problem (Chapter 4 of D'Agustino's 'Adaptation, Resistance and Access to Instructional Technologies: Assessing Future Trends In Education' (2010) offers a discussion from academics in Turkey). While some of this may be explained by traditional pedagogy in which the tutor is the key source of information, it has also been shown that even students involved in blended learning in a university in the UAE failed to perceive the educational worth from the use of social media (Alzouebi & Isakovic, 2014). Implicit in the discussion in their paper is that social interaction is simply not seen as a key ingredient in effective learning, reinforcing the view that Arab countries are less comfortable with the constructivist ideas that are often taken for granted in Western countries, especially in the more conservative Arab nations (Al-Seghayer, 2014; Oyaid, 2009).

The apparent value of a resource must also be considered alongside its costs, whether financial or time-based. Consequently, learning how to use the tool can be seen as a time cost which students weigh against their expected returns (Bloxham & West, 2004). For this reason, a focus on ease of use is customary in most discussions of technological change, and indeed change in general. However, using e-learning

technologies in Arab countries can also be linked to notions of independence, which adds a complicating factor rarely considered in the Western educational research literature. Issues around responses to technological change might therefore need to be understood in a broader context of what staff and students really need to change. The discussion of e-portals is a good example of this, where one-click solutions for searching library services or accessing course material can encounter resistance (Randeree, 2008). However, Randeree also describes how an increased emphasis on independent learning runs in tandem to the introduction of e-learning resources. This highlights how there are other costs which need to be evaluated, such as any emotional cost due to change.

Changes to learning habits can also be difficult to achieve if students see those transformations as imparting a perceived worse learning experience. For example, Tatnall (2009) notes how e-portals are popular with students, but how this might not be the case if students see those portals as reducing contact opportunities with their tutors. One risk in such cases could be that e-learning is regarded as a poor substitute for personal communication, but it is also possible that negative feelings towards student-centred practices are projected onto the technology. It might, for instance, be the case that the resistance from the late adopters in Randeree's study was really resistance to the idea of students having to access material independently rather than having to access it on a computer. Nevertheless, it must also be remembered that the opposite case, in which fear of the technology caused resistance even for those who supported the concept of more student independence, was also evident in responses (Randeree, 2008). It has additionally been observed that it is the need for change that is the most difficult element of introducing learning technology (Owen & Allardice, 2008), so it seems that fear of technology can be a result of a more widespread fear of change.

2.3 Study habits of late-adopters and enthusiasts

With learning technology typically being implemented later in Arab countries than in their Western counterparts, discussions such as Randeree's (2008) often focus on limitations and change approaches which seek to help late adopters to catch up. A risk here is that the needs of early-adopters are overlooked. A qualitative study in a research-intensive environment helps to address this issue, helpfully illustrating how research-active academics and research students are demanding the latest innovations from their libraries (Taha, 2012). In such cases, ease of use is not as important as the power of such resources, and the electronic nature of the delivery is taken for granted as the most effective way of accessing global resources.

Similarly, discussions within the field of librarianship appear to be converging on integration with VLEs as a key feature of contemporary library resources (e.g., Boumarafi, 2010), raising the stakes for those resisting change who may find themselves unable to access some key resources. While interviewees in Taha's (2012) study saw a need for modernised library tools to facilitate access to resources they already knew existed and desired access to, Boumarafi's (2010) study highlights how updating such tools can remove numerous minor barriers to access, but comes with the accompanying risk that it creates one immense barrier if staff or students are unable to use the VLE/LMS (learning management system) portal effectively.

Subject-specific literature also illustrates how enthusiasts are not just those with a fondness for new technology, but also include those who see technology as part of their current or future professional practice. As well as making change easier to achieve, staff and students in these subjects seem less likely to perceive technological change in isolation. An example of technological and pedagogical change developing in tandem can be seen in engineering, with positive experiences and learning gains reported in the UAE

(Ahmed & Zaneldin, 2013). At this point, there seems an obvious link to the need for students to be familiar with the latest technology as part of their learning, although this argument seems stronger for specialist software than for tools such as Blackboard. Since tools like Blackboard and Moodle are only used in academic institutions, there is little value in becoming proficient in them if not intending to have an academic career.

As with the research-intensive staff and students in Taha's (2012) study, it seems that the demands of the subject can create enthusiasm for technological change, which may support a communities of practice perspective of seeing universities as made up of small, largely self-contained teams, each with their own culture, practices and ways of conceptualising technological change.

In this respect, engineering education has many parallels with medical education, as both appear to take for granted that being conversant with technological developments will be integral to students' future professional practice. A recent guide to mobile technologies in medical education was published for practitioners in Oman, highlighting that practitioners needed a thorough theoretical understanding of technology which would progress through their training from undergraduate to residency (Masters, Ellaway, Topps, Archibald, & Hogue, 2016). While some aspects of the guide focus on the utility of specific new technologies, the focus on theory illustrates how medical practitioners need to develop their technological literacy and independence more generally in recognition of a fast-changing future in which mobile technology is expected to feature profoundly.

2.4 Cultural expectations of learning habits

Whereas the literature outlined so far has considered learners either as individuals or as part of a subject-specific community, there is also a need to consider learning habits as reflecting cultural expectations. Most significantly, it has been noted that students and

academics in Arab countries can be reticent with adopting constructivist approaches to teaching and learning (Al-Senaidi, Lin, & Poirot, 2009; Porcaro, 2011). A survey of attitudes to engagement with Moodle showed related perceptions; students saw themselves as engaging with their tutor rather than with course material (Abdelraheem, 2012). There are, however, some key limitations to Abdelraheem's work, both in general and with respect to the subject of this thesis. The study is small-scale, surveying only 57 students, within Turkey, and uses some emotive language which suggests a bias in favour of learning technology. Nevertheless, the study has been cited in other studies in neighbouring countries and is generally seen to illustrate how students are now largely comfortable with learning technology (e.g., Thindwa, 2016), thereby challenging stereotypes that gender or age profiles might make, making implementing learning technology more problematic. It will therefore be important to consider whether such concerns from staff about how students might respond, might be either mistaken or even used in a deliberately obstructive manner.

Another limiting factor to adoption of learning technologies could be perceptions in wider society regarding the quality of online learning. One of the main advantages claimed for blended learning, for example, is that it offers access to some of the world's most prestigious universities without the need and expense of studying abroad. Some institutions already trade on a strong reputation for high-quality distance learning, such as the United Kingdom's (UK's) Open University (Daniel, 2015). Others add an altruistic flavour by offering world-class learning for a nominal fee, such as the wide range of Harvard and Yale programmes available through EdX, many of which include access to tutor support or office hours (Lazaroiu, Popescu, & Nica, 2016; Voigt, Buliga, & Michl, 2017).

The issue of the quality of online education is therefore largely resolved in Western countries and, while there may still be some condescension about getting a degree through the 'back door', there may even be additional standing for those studying online since they are assumed to require greater self-motivation and self-management (Lowes & Lin, 2015). Crucially, however, this seems not to be the case in the Middle East, despite some early optimism (Elango, Gudep, & Selvam, 2008). A large-scale survey of businesses in Egypt and Oman found that not only were the qualifications gained from studying online regarded as less prestigious than those programmes attended in person, but that the quality of learning on such programmes was also assumed to be inferior (Sadik, 2016).

While some of these misgivings could relate to the risks of ensuring a candidate has actually done the work themselves or has studied at a real university rather than a diploma mill (Knight, 2014), such concerns are also raised in traditional brick-and-mortar institutions (Race, 2015). It therefore seems that uptake of e-learning may be limited if students feel that developed technological literacy is not valued by employers, although there are already signs of such attitudes being challenged in certain professional disciplines such as engineering (Ahmed & Zaneldin, 2013) and medicine (Masters et al., 2016).

2.5 Responses related to specific design aspects of learning technology

Small changes to usability have been shown to have a dramatic impact on student engagement with a learning platform, which suggests that poor user experience – rather than users lacking necessary skills or motivation – could be a substantial barrier. An example from Oman shows how small improvements to a learning platform as part of a UK-based blended learning programme improved student engagement five-fold (Bentley, Selassie, & Parkin, 2012), although it should be noted that this was measured in site hits,

which might be a rather crude measure of engagement. Nevertheless, the dramatic increase in hits can also be interpreted alongside interviewee data saying that the learning platform was "the most under-utilised tool" on the programme (Bentley, Selassie, & Parkin, 2012, p.83). This further supports the argument that students are ready and waiting to engage but require tutors to be proactive first.

Reasons for differences in attitudes based on discipline area can also be considered as relating to the maturity of technology within the discipline, the extent to which technology has adapted to meet the specific requirements of the subject, or the development of a community of practice. For example, Randeree's explanation of learning technology uptake in engineering acknowledges that pedagogy in engineering is continually evolving in response to new technologies, with adaptability to change established as a key value over several decades (Randeree, 2006). Adapting to take advantage of new pedagogical tools is therefore consistent with the values of the community of engineering educators as well as benefiting from technology being gradually integrated into the subject area and therefore becoming mature and established.

2.6 Links with attitudes to active learning

Randeree (2006) argues that being open to technological innovations creates fertile ground for developing active learning and constructivist learning principles. However, with traditional views deeply entrenched in the Middle East, this seems to be a leap in logic since gradual and incremental change within an overarching traditional pedagogy seems more the norm. An alternative approach is to see the development of constructivist learning approaches and skills in online learning as something to be explicitly taught, with some encouraging results demonstrated in business education in the UAE that staff are suitably passionate about these new approaches (Rush, 2008), echoing the key requirement of staff enthusiasm highlighted in a factor analysis of

responses from university students in the UAE (Selim, 2007). Similar encouragement, also from the UAE, shows success in developing independent learning alongside skills in using learning technology for a general study skills programme as part of the university library provision (Boumarafi, 2010), although as with Rush's (2008) study, this suggests that skills need to be front-loaded by specialist staff and cannot yet be integrated throughout a longer programme.

Some models of pedagogical change in Arab countries have also included technological innovations as part of their definition, viewing collaboration as incorporating the use of collaborative tools such as social media (Al-Abri, Jamoussi, Kraiem, & Al-Khanjari, 2017). Other discussions such as language learning needs in Kuwait have similarly conceptualised independent learning and e-learning as intrinsically linked (McBeath, 2011).

However, engagement with critiques of constructivism, especially viewed through cognitive load theory, can offer a more rounded understanding of pedagogical approaches to initiate a move to student-centred forms of pedagogy. In this context, Kirschner et al.'s (2006) research examined important concerns regarding expected positive outcomes offered by minimal guidance during instruction. This approach is relevant to my research, especially in terms of the context of constructivist, problem- and discovery-based, experiential design, and inquiry-based teaching methods.

Cognitive load theory argues that students who possess limited cognitive and learning resources can become further challenged when teaching and learning assignments overload these limited resources, especially when the additional data or assignments may be superfluous to learning requirements; such approaches can attenuate the efficiency of learning outcomes. However, it is also important to understand that constructivism includes an entire spectrum of practices in which guided approaches and

student-centred teaching initiatives can be implemented (Kirschner et al., 2006). Whilst it is conceded that Kirschner et al.'s (2006) critique may indicate potential shortfalls posed by adopting an extreme constructivist approach, it does not invalidate or lessen the value of the core principles of constructivism, such as active engagement, meaningful learning, and knowledge construction. A balanced approach is important, and a key component of thinking behind my study is that I see the value for a nuanced interpretation of constructivism that serves to combine the concept of teacher-based guidance and the autonomy of the learner. This approach integrates both explicit instructional benefits as a mechanism to attenuate the cognitive load with viable opportunities for the learner to construct and acquire valuable knowledge via actively conducting collaboration, exploration, and problem-solving.

It is posited that my research considers student-centred pedagogy as necessary, because this approach serves to align with a more contemporary understanding of how to leverage effective learning techniques and practices. I argue that in the complex and fast-changing current modern world in which we live, merely adapting and using rote memorisation and passive reception of information are not appropriate or enough to help learners to become successful students. Rather, qualities such as collaboration, critical thinking, creativity, and self-directed learning capabilities are essential to success (Beetham & Sharpe, 2013; Kirschner et al., 2006). There are opportunities facilitated by student-centred pedagogies to develop basic competencies by enabling students to assume ownership of their learning assignments, research topics of interest, and create valid meanings via authentic, real-world experiences.

These student-centred teaching and learning strategic approaches can engender motivation and engagement by the recognition of a learner's diverse background, interests, and their unique learning approaches (Kirschner et al., 2006). Such an approach

can offer flexibility and personalisation to emerge and shape their learning experiences. In turn, educators can address the individual aspirations of their students and cultivate a learning environment that is positive in terms of learning outcomes and embraces the student's own personal individual growth and development.

2.7 Cultural Comparisons

Further exploration of attitudes to learning can be made through cultural comparisons, with one study focusing on engagement with Rich Site Summary (RSS) feeds among Lebanese students in Lebanon compared with British students in the UK (Tarhini et al., 2015). While still modest, usage was higher in the UK with the key factors cited as perceived usefulness and ease of use while the key recommendation was that tutors should take the lead in promoting the technology to students.

In addition to seeing Oman and the neighbouring UAE as having their own distinct e-learning development characteristics, some issues can be thought of as being common across the Middle East. This is most relevant when considering how well learning technology embeds within pedagogy. Crucially, while discussion of e-learning in Western countries can emphasise its ability to drive pedagogical change (Beetham & Sharpe, 2013), the focus in the Middle East is more on how e-learning can be assimilated into existing traditional pedagogy (Iskander, 2014). This illustrates how models of pedagogical change may be unsuitable if applied to a Middle East context, since the region as a whole seems unlikely to follow the typical progression from didactic to constructivist pedagogy. Similarly, technological change which stimulates learners to develop along constructivist principles might also need reconsidering in a Middle East context as such development may be unwelcome.

Even here, however, there are some signs that regional or national assumptions could be too sweeping. In a study of computer science students in Oman and New

Zealand, it was found that personality type – either introvert or extrovert – was a better explanation for using e-learning tools effectively than nationality (Al-Dujaily, Kim, & Ryu, 2013). Studying computer science students clearly helped to control different levels of comfort with technology. Because there would not be any technology novices studying computer science, everyone will be much more proficient than the average student. There was a higher proportion of introverts from the Oman sample than in the New Zealand sample, so results might not be generalisable. For example, non-computer science students in Oman may be much less comfortable with learning technology than their New Zealand counterparts.

Nevertheless, the Oman/New Zealand study illustrates how student disposition can better explain engagement with learning technology than nationality, with extroverted Omani students (admittedly, a rarer group than extroverted New Zealanders) being demonstrably more comfortable with learning technology than were introverted Omani students or introverted New Zealanders. Perhaps most interesting is the in-group comparison, showing no statistically significant differences between extroverted students in Oman and extroverted students in New Zealand or, in the other grouping, introverted students in Oman and introverted students in New Zealand. This illustrates that some regional stereotypes may be true in that the Omani students were more likely to be introverted, but that the assumptions about approaches to e-learning were invalid in the significant minority of cases where Omani students were extroverts. Likewise, introverted students in New Zealand did not appear to derive any benefit from their national context since they engaged no better with e-learning than introverted students in Oman. There are also some signs that students in the UAE are becoming more extroverted, although the data for this (Al-Qirim, Yammahi, & Yammahi, 2015) is so far relatively small-scale and has yet to be subjected to the full rigour of peer review.

2.8 Practical barriers in the Middle East

The cultural considerations outlined in the previous section add helpful context, especially for evaluating the transferability of key practices or concepts from Western countries to a Middle Eastern context. However, there are also more mundane barriers. Significantly, the latest technologies are rarely available in Arabic and so even attempts to be innovative, such as with early adopters of Blackboard in Taha's study (Taha, 2007), may be limited to English-language programmes. This may help to explain research interest in using mainstream tools for educational purposes – with learning technologies unable to match their rapid development, it seems reasonable that tools such as YouTube and Facebook will be used instead (Perrett & Minhas, 2016), particularly as both offer Arabic interfaces.

Similarly, a study of engagement with e-books among students in Abu Dhabi found engagement to be low – in part due to cumbersome software (Andersen & Russell, 2012), while a study looking at international inter-library loans found that the Middle East was one of the regions with which leading university libraries were most reluctant to share resources (Munson & Thompson, 2018). As Munson and Thompson (2018) point out, such barriers can understandably drive students to seeking less legitimate online resources, with the #ihazpdf hashtag on Twitter and the growth of Sci-Hub being key examples. It has likewise been noted that poor access arrangements for the latest medical literature has encouraged substantial growth in online piracy, including in the Middle East, showing that some students and practitioners are unwilling to wait for official tools and resources to catch up and provide what they need (Bohannon, 2016).

A general lack of training availability for staff also clearly contributes to computer anxiety being a factor for poor uptake, but a study in Oman of tutors' satisfaction with an LMS system argued that a wider range of factors needed to be considered if tutors were

to engage with the LMS on a regular or ongoing basis (Al-Busaidi & Al-Shihi, 2012). These highlight some practical considerations related to the organisational structure of many universities in the Middle East. In particular, the scarcity of organisational characteristics such as support from management or incentives to train in the LMS tools were highlighted, although this study appears to consider the organisation as a whole rather than seeing groups of academics as having their own communities of practice. It remains to be seen whether this would be a helpful additional theoretical lens or if HE in Oman is more homogeneous than, for example, its UK counterparts.

2.9 Expected changes

Any literature review addressing technology will need to be constantly revised to keep up-to-date, but it is also helpful to look at some of the predictions being made about the future direction of e-learning in the region. One of the most promising developments appears to be M-learning, with the rise in popularity and power of smartphones stimulating innovation through application (app) development (Sharma, Sarrab, & Al-Shihi, 2017). There remains the persistent issue of only the most popular apps being available with Arabic interfaces, but the freedom of customisation and flexibility of the devices suggests that students may increasingly become curators of their own technological toolkit. As students choose the most suitable resources from their university, commercial providers and smaller developers, researchers will be able to explore how study habits are influencing interaction with apps while, at the same time, apps are influencing study habits. While there are ethical issues to overcome (Anshari, Alas, Sabtu, & Hamid, 2016), the potential for 'Big Data' insights from mobile data (The Blackboard Engagement Centre gives some statistics to see if materials are effective, and attendance can be tracked with smartphone check-ins) might also give new perspectives on how students are using smartphones to learn.

2.10 Drawing the literature review together

So far, this review has highlighted key areas of research literature relevant to how learning habits may be changing among Omani higher education (HE) students. A range of studies from across the Middle East has been selected and organised to show key themes, such as how e-learning is perceived by stakeholders such as staff, students and employers. Cultural expectations, including across the Middle East region as well as nationally and within each university's own culture, have also shown how slow pedagogical change may limit the impact of new technology on learning habits. Some of the assessment for learning literature has been used to contextualise this issue, most significantly that students may not see a need for change unless they perceive their current habits as unsuitable for their assessment tasks.

More broadly, and less cynically perhaps, it has also been suggested that change in learning habits can be stimulated without the need for substantial changes to assessment. Enthusiastic staff, or even whole communities of staff, students and practitioners, can drive engagement with technologies which become integrated with learning itself. While there are plenty of examples of technology being taught for its own sake or as part of digital literacy in study skills programmes, engineering and medicine have provided examples of effectively blurring the line between learning *how* and learning *with* technology (Anshari et al., 2016; Sharma et al., 2017). This outline of the literature review up to this point ended with looking to the future, both in terms of practical barriers such as language customisation (which will hopefully soon be overcome) and in predictions for emerging technologies such as M-learning. As these new innovations start to be used by students and practitioners, the literature will be able to better reflect on how all these inter-related issues are developing at a time of substantial changes in technology, higher education, and Omani society in general.

2.11 Developments in learning technology in Oman since 2017

Learning technology is continually evolving as innovations and options emerge. This implies that understanding learners' changing habits must be on a par with the transforming environment that these learners possibly experience, including how new systems are designed, to accommodate the expectations of the techniques/modes in which students might be required to learn in the future. Furthermore, applying the Education Research Complete, British Education Index, and Education Resources Information Center (ERIC) databases, search terms of e-learning, m-learning, blended learning, online learning, mobile learning, VLE, learning + tablet, and learning + smartphone were utilised with a date filter of 2017 to 2022. This aimed to provide a comprehensive overview of recent advancements in this expansive area which could then be narrowed down to the specific focus of this study. Since the location filter on the databases relies on metadata which are not always consistent or complete, location filtering was not used as this could be performed manually as a search term filter in the Mendeley program. Due to delays in the publication cycle, the environment described in this literature is the most up-to-date possible using peer-reviewed material. However, it may still be missing the very latest innovations that are just beginning to emerge in other sources of literature such as conference discussions and online blogs.

The Boolean expression for this search was: (mobile learning or mlearning or m-learning) OR vle OR (elearning or e learning or online learning). This search yielded 3,490 results in peer-reviewed publications in English published since 2017. These were imported into Mendeley for more exhaustive search terminologies to be used to categorise the results by considering the titles, abstract, and meta-data for the term 'Oman', effectively creating a location filter which did not rely on metadata. The only minor negative here was an increase in false positives from papers discussing Oman, but were

located elsewhere, although this was rare. There were also a few results from academics personally associated with institutions in Oman, who were working on papers in other countries, but again, these were rare and it was decided that they should be included as they represent some of the body of knowledge being developed within Oman. Even including some of the less immediately apparent false positives, the 'Oman' search filter was able to reduce results to a manageable 15 for more detailed consideration of relevance and quality. These are presented in the audit trail in Table 2.1.

Table 2.1: Audit trail of initial 15 papers following Mendeley filtering

Author(s) and date	Title	Include/exclude
Al-Abri, A., Jamoussi, Y., Kraiem, N., & Al-Khanjari, Z. (2017).	Comprehensive classification of collaboration approaches in E-learning.	Include: non-empirical, but comprehensive overview
Al-Balushi, S., Al-Musawi, A., Ambusaidi, A., & Al-Hajri, F. (2017).	The Effectiveness of Interacting with Scientific Animations in Chemistry Using Mobile Devices on Grade 12 Students' Spatial Ability and Scientific Reasoning Skills.	Exclude: school-level (not HE)
Al-Emran, M., Mezhuyev, V., &	Students' Perceptions Towards the Integration of Knowledge Management	Include: empirical study on m-learning in Oman

Author(s) and date	Title	Include/exclude
Kamaludin, A. (2018).	Processes in M-learning Systems: A Preliminary Study.	
Al-Harthi, A. S. A., Campbell, C., & Karimi, A. (2018).	Teachers' Cloud-Based Learning Designs: The Development of a Guiding Rubric Using the TPACK Framework.	Exclude: school-level (not HE)
Al-Maroof, R. A. S., & Al-Emran, M. (2018).	Students Acceptance of Google Classroom: An Exploratory Study using PLS-SEM Approach.	Include: empirical study on e-learning and m-learning in Oman
Al-Shihi, H., Sharma, S. K., & Sarrab, M. (2018).	Neural network approach to predict mobile learning acceptance.	Include: empirical study on m-learning in Oman
Buabeng-Andoh, C., Yaokumah, W., & Tarhini, A. (2019).	Investigating students' intentions to use ICT: A comparison of theoretical models.	Include: empirical study on e-learning in Ghana, but with researchers based in Oman
El-Masri, M., & Tarhini, A. (2017).	Erratum to: Factors affecting the adoption of e-learning systems in Qatar and USA: Extending the Unified	Exclude: correction to paper already found in this search (Salloum, Al-Emran, Shaalan, & Tarhini, 2019) which does not

Author(s) and date	Title	Include/exclude
	Theory of Acceptance and Use of Technology 2 (UTAUT2).	focus on Oman (false positive in search due to author affiliation with Sultan Qaboos University in Oman)
Malik, S. I., Shakir, M., Eldow, A., & Ashfaque, M. W. (2019).	Promoting Algorithmic Thinking in an Introductory Programming Course.	Exclude: focuses more on pedagogical change in terms of subject-specific pedagogy rather than e-learning or m-learning
Salloum, S. A., Al-Emran, M., Shaalan, K., & Tarhini, A. (2019).	Factors affecting the E-learning acceptance: A case study from UAE.	Exclude: paper does not focus on Oman (false positive in search due to author affiliation with Sultan Qaboos University in Oman)
Sarrab, M., Al-Shihi, H., Al-Khanjari, Z., & Bourdoucen, H. (2018).	Development of mobile learning application based on consideration of human factors in Oman.	Include: empirical study on m-learning in Oman
Sarrab, M., Al-Shihi, H., Al-Manthari, B., &	Toward Educational Requirements Model for Mobile Learning	Include: empirical study on m-learning in Oman

Author(s) and date	Title	Include/exclude
Bourdoucen, H. (2018).	Development and Adoption in Higher Education.	
Sharma, S. K., Sarrab, M., & Al-Shihi, H. (2017).	Development and validation of Mobile Learning Acceptance Measure.	Include: empirical study on m-learning in Oman
Tawafak, R. M., Romli, A. B. T., & Alsinani, M. (2019).	E-learning system of UCOM for improving student assessment feedback in Oman higher education.	Include: empirical study on e-learning in Oman
Tawafak, R. M., Romli, A., Malik, S. I., Shakir, M., & Farsi, G. Al. (2019).	A Systematic Review of Personalized Learning: Comparison between E-Learning and Learning by Coursework Program in Oman.	Include: empirical study on e-learning in Oman

The most common reason for excluding a paper was because it was related to school-level participants rather than students in higher education (Al-Balushi, Al-Musawi, Ambusaidi, & Al-Hajri, 2017; Al-Harthi, Campbell, & Karimi, 2018), and hence, beyond the scope of this study. Nevertheless, it is important that innovations in e-learning and m-learning continue for these students, so that there may be greater digital literacy in future HE students, as they would have effectively 'grown up with' the

technology. This could be especially significant in terms of perceived ease of use, which was a key theme in many of the included studies.

Another reason that papers were excluded was because they were not produced in Oman, but had been found through author affiliations with institutions in Oman. This may also be regarded as indicating positive change since, even though the research itself was not accomplished within Oman (Salloum et al., 2019), collaboration ensures that the knowledge gained in such studies is being co-constructed with academics in Oman; hence, it may possibly support future studies and innovations.

Following this further filtering, a total of nine papers were included as sufficiently high quality and relevant. The list of names in Table 2.1 illustrates that there are key academics publishing in this area up to the year 2022, particularly in the field of m-learning. This may be partly due to funding through a grant awarded by the Sultanate of Oman in support of two of the papers written by the same lead authors (Sarrab, Al-Shihi, Al-Khanjari, & Bourdoucen, 2018; Sarrab, Al-Shihi, Al-Manthari, & Bourdoucen, 2018).

In terms of the basis on which the studies were conducted, methodologies generally favoured self-report strategies in interviews and surveys, with a tendency towards quantitative analysis and larger sample sizes rather than in-depth qualitative studies of smaller samples. In fact, six of the nine papers used questionnaires (Al-Emran, Mezhuyev, & Kamaludin, 2018; Al-Maroof & Al-Emran, 2018; Al-Shihi, Sharma, & Sarrab, 2018; Sarrab, Al-Shihi, Al-Khanjari, et al., 2018; Sharma, Sarrab, & Al-Shihi, 2017; Tawafak, Romli, & Alsinani, 2019). Each of these studies also derived from a large sample, ranging from 296 students (Tawafak et al., 2019) to the same group of 806 students used in two studies (Sarrab, Al-Shihi, Al-Khanjari, et al., 2018; Sharma et al., 2017). The investigations typically used standard descriptive statistics, although some more advanced and inferential methods were used with predictive model construction in

one paper (Al-Shihi et al., 2018) and forms of factor analysis in two papers (Sarrab, Al-Shihi, Al-Khanjari, et al., 2018; Sharma et al., 2017). However, the analysis performed in these two papers is almost identical and on the same sample of students, so it might be misleading to think of these as two distinct studies.

Only one of the studies could be considered mixed-methods, and even then the qualitative aspect was secondary to the quantitative parts of the study as it only involved analysis to develop a set of requirements (Sarrab, Al-Shihi, Al-Manthari, et al., 2018). The only substantial qualitative inquiry in any of the studies involved using a classification framework to critique ten different forms of implementation as a way of focusing discussion on the implicit theories of learning behind e-learning approaches (Al-Abri, Jamoussi, Kraiem, & Al-Khanjari, 2017), although this is somewhat questionable as there is little discussion of how the analysis was conducted and whether there was a strong consensus on the judgements made by the team of authors or with other stakeholders. Despite this, the study was included as it is one of the most recent studies in Oman to look at the assumptions which underpin e-learning pedagogy implementations.

Another point of interest was to see in what theoretical terms these nine papers framed developments in the use of e-learning and m-learning over the last 2 years. The most popular conceptual framework was the Technology Acceptance Model (TAM), which was drawn heavily upon in several studies (Davies, 1989). This model supposes that attitudes towards using technology are primarily influenced by perceived usefulness and perceived ease of use. The consequential attitude towards using technology also combines with a direct influence from perceived usefulness to establish a user's intention to use, all of which have to be in place before the technology actually is used. For e-learning, this tends to put the emphasis on external variables in the model, so studies focus

on participants' perceptions of usefulness of technology versus their perceptions of ease of use. For instance, the simplicity of the TAM suggests that there cannot be a behavioural intention to use the technology without at least some level of perceived usefulness, regardless of how easy to use the technology might be. As such, e-learning or m-learning will only be used when it convinces teachers or students that learning is either better or more efficient than the current model. Other factors – such as reducing the cost of education or being entertaining to use – might not therefore have an influence on users' willingness to be involved or participate.

Despite the popularity of TAM, there were also signs that this framework was being critiqued by comparing it with other approaches, particularly in one paper which specifically looked at how well the Technology Acceptance Model would map onto a non-Western context (Buabeng-Andoh, Yaokumah, & Tarhini, 2019). This study offers perhaps the most impactful finding of the nine papers since it demonstrates through a large-scale survey and equation modelling that many of the most popular theoretical frameworks in this area of the literature perform equally well when predicting uptake of e-learning in the context of Oman, concluding "no one model is better than the other to predict intention to use technology. However, the integrated model explained attitudes toward the use of technology much better than both TRA [theory of reasoned action] and TAM, and may be the best model to choose when this variable is of specific interest" (Buabeng-Andoh et al., 2019, p.655). Firstly, the paper establishes that the models function in Oman in much the same way as they do in Western countries. This in itself is an important finding. Secondly, and perhaps more importantly, it suggests that there is far more similarity than contrast in how different theoretical frameworks predict technology uptake. This may suggest that further qualitative research is needed to get at the underlying factors which explain engagement with technology.

The studies also generally discuss learner preferences and attitudes to technology rather than how students actually use e-learning or m-learning or any influence on broader study habits. The aims of the papers, particularly those involving Assistant Professor Sarrab at Sultan Qaboos University, seem to be more about designing e-learning or m-learning in such a way as to engage students and give them what they want rather than considering pedagogical need. This point is elaborated upon in the 'gap' sub-section 2.13, but first the key themes arising in these nine papers are evaluated.

2.12 Key elements from the review

None of the studies in this review explicitly looked at learner habits and tended to focus on design and implementation of e-learning or m-learning instead. Nevertheless, there were relevant findings and discussions which can be included. For instance, the latent variables found through factor analysis in Sharma et al. (2017) were labelled as flexibility, suitability, enjoyment, usefulness, feasibility, and efficiency, which could imply habits around collaborative learning. Sharma et al. (2017) went on to argue that their own open source project – Mobilearn – offers all these features to a greater extent than current platforms such as Moodle, so much of the discussion could be biased by self-promotion even if there is no commercial element to the research. For the purposes of this review, however, the finding is still relevant as it demonstrates that learners state that they want these six characteristics in their m-learning experience. From this, an inference can be made – as is made in the design of Mobilearn – that learners' habits using m-learning are similar to their habits when using social media. An example of this is the ability to message in private or in public, join groups of one's own choosing rather than being assigned by a tutor, and having off-topic discussions which do not relate to module content (Sharma et al., 2017).

How these habits in using a platform relate to habits in learning remains unexplored, but there is some suggestion in Sharma et al. (2017) that students expect to interact in a largely self-determined and organic manner, which could suggest a broadly constructivist view of learning. Just as with social media in general, students also seem to expect to be able to access the same information in different ways so that there is no penalty for those who only wish for minimal engagement with an m-learning platform, which could suggest that students expect to have their own learning preferences accommodated to at least some extent.

The study by Al-Abri et al. (2017) may offer more in-depth insight into learning habits. If Sharma et al. (2017) show a desire for m-learning platforms to behave like social media, then Al-Abri et al. (2017) show how students might behave in such an environment. The key point here is that collaboration through social media was found to be integrated into the broader learning experience as students developed their own discussions online which went well beyond just sharing content. More specifically, Al-Abri and colleagues emphasise that critical thinking and problem-solving skills are integral to successful implementation of e-learning and m-learning. This demonstrates how some students are using social media tools to continue discussions beyond the classroom, suggesting that e-learning and m-learning could be helpful for practising skills which take longer to develop. This finding may go against content-led approaches like a flipped classroom, so it offers valuable insight into what learners are doing with social media tools and what habits they develop, especially if these habits are more based on discussion after class rather than preparation for class.

These two studies give encouraging insights into how students might use e-learning or m-learning in the future based on their current use of social media tools as in Al-Abri et al. (2017) or students' preferences for a new platform as in Sharma et al.

(2017). However, there is a leap in both these papers since students are not actually using learning platforms as a major component in a programme of study. The study of how students engage with Google Classroom (Al-Maroof & Al-Emran, 2018) is therefore promising in this regard, but is at such an early stage and stays so firmly within the TAM theoretical framework that the paper says very little about learning habits and focuses too much on whether there is student "acceptance" (Al-Maroof & Al-Emran, 2018, p.112) of Google Classroom. Likewise, a methodology which looks only at students' claimed preferences such as in Al-Emran et al. (2018) shows that students are on the whole quite keen to try new things with technology, but again is too restricted in just looking at getting students on a platform and using it rather than considering what it is they do and whether they are truly engaged or learning.

The same problem of focussing too much on acceptance is evident in Ah-Shihi et al. (2018), whose work is still commendable for looking at how m-learning can enrich the learning experience of students in developing countries and demonstrates the potential for Oman to take a philanthropic lead in this area. Their finding that the perceived entertainment potential of a device or platform is the best single predictor of engagement with m-learning has yet to be explored for transferability or generalisability, but could suggest that attempts to emulate social media within learning platforms is neglecting the important consideration that existing social media tools are highly engaging and entertaining. Rather than being a distraction, as might be assumed, it seems that this potential for entertainment could be important for engagement with m-learning, at least in the early stages as habits are formed. This is supported by another paper, this time looking at students in Oman, which puts attitudes to technology as the most important predictor of students stating that they are willing to engage with ICT more generally (Buabeng-Andoh et al., 2019). This may suggest that any consideration of e-learning or

m-learning habits must start with looking at the habits learners have with their current use of ICT and social media.

Looking beyond these general findings about uptake and engagement with ICT and whole e-learning or m-learning systems, one of the papers (Tawafak et al., 2019) went beyond just asking students about their perceptions and also looked at changes in learning, which may be relevant to a consideration of learner habits. This also dealt with the recurrent problem of poor learner engagement with feedback in higher education (Price, Handley, Millar, & O'Donovan, 2010), which calls into question whether students actually learn anything from feedback or if it is a wasted learning opportunity (Boud & Molloy, 2013). Tawafak et al. (2019) were able to demonstrate using student grades that the technology-assisted feedback led to more engagement with feedback, which also led to improved student performance. Again, this is a preliminary study with just one student cohort and so needs to be treated with caution around novelty effects. In the context of student engagement with feedback being such a key concern, however, the study suggests that learning habits can change rapidly for the better when students use an interactive technology platform. This adds weight to the claim that technology can help to drive pedagogical change (Beetham & Sharpe, 2013) and that change does not necessarily need to happen in small, incremental steps.

Taken together, the nine studies can be seen as representing how the literature on e-learning and m-learning in Oman's higher education system has progressed up to the year 2020. They show that attention is focused on the very early stages of implementation, particularly student preferences for new platforms or what will generate student interest. In this respect, there appears to be consensus that there is visible enthusiasm among students and that much of this could be down to growing enthusiasm for ICT and social

media in general, emphasising the importance of interactivity, customisability, and entertainment in new e-learning and m-learning platforms.

Key themes around perceived usefulness and ease of use, drawing upon TAM as a theoretical framework, appear to be shifting in this direction of looking more at these features of interactivity, customisability, and entertainment, although it is possible to see how these three features could still be framed in terms of TAM as students see these all as part of perceived usefulness. While it comes close to the much-disputed 'digital native' label (Brown & Czerniewicz, 2010), there appears to be a growing shift away from discussion of usability as greater use of ICT and social media in life more generally seems to assume greater familiarity with learning platforms. It may also simply be the case that learning platforms are giving more thought to design and are better emulating the intuitive features of large social media platforms.

In those few studies which investigated the nuances of what students are doing with e-learning and m-learning, there is some encouragement that interactivity is supporting greater engagement and that e-learning and m-learning provide space for higher-order skills rather than simply being about delivering content. The next challenge may therefore be to move away from looking at how to get students onto and using these platforms, but to look at how the platforms can continue to support the positive learning habits that students seem to be developing in these new spaces.

2.13 Identifying a gap

The review has demonstrated that the recent literature on e-learning and m-learning in Oman only tangentially addresses learning habits and focuses heavily on the early stages of implementation in terms of encouraging students onto a new platform and asking them what they want to do with it. As such, the literature seems more about accommodating current habits rather than encouraging or facilitating new ones. This

presents a clear gap in the literature around students' current learning habits, constraints they face in how they might want to learn, and new ways of learning that might be facilitated by e-learning or m-learning options. With the current pace of development, there is also a gap in practical knowledge of what kinds of learning habits might be supported by the latest innovations, and it is striking that there is a complete lack of practitioner research or 'on the horizon' research coming out of Oman to discuss how teachers are finding their way with new technologies.

It was noted earlier how the papers included in this study were mostly quantitative and survey-based, with the dominance of the use of the TAM, meaning that the focus was often narrowly concentrated on barriers to acceptance based on either difficulty using new tools or a lack of perceived usefulness. One of the included studies (Buabeng-Andoh et al., 2019) suggested a way forward from this largely descriptive position, showing that several theoretical frameworks led to the same conclusions about technology uptake and that the issues faced in Oman were more similar than different to studies in Western countries. From this position, the studies in this review which used factor analysis (Sarrab, Al-Shihi, Al-Khanjari, et al., 2018; Sharma et al., 2017) can be seen to build a better understanding of what the reality of implementation is at the moment. This helps draw attention to key barriers to further uptake, including some indication that social media and use of mobile devices is becoming far more prevalent in Oman and this is having a positive impact on perceived ease of use of related learning platforms.

These studies also suggest that the pace of change is not particularly a problem for students – which makes sense since so much is new to them when they transition to university anyway. Indeed, students seem to increase their expectations as they engage with m-learning, demanding more flexibility and mobility. This may pose a substantial challenge to staff and institutions in the future as the pace of change and resource

development will fail to keep pace with the dominant social media platforms. As has been found in studies of student collaboration in Western countries (e.g., Mnkandla & Minnaar, 2017), 'tech-savvy' students who do not feel that a learning platform meets their needs will simply make their own provision on platforms such as Facebook or WhatsApp. At present, the literature base in Oman offers no insight into such behaviours – it is simply not known to what extent students are using technology to self-organise their own learning and if or how this relates to their engagement with formal e-learning or m-learning offerings from their institutions.

In terms of filling this kind of gap, Al-Abri et al. (2017) offers some insight into how such qualitative studies might helpfully proceed. Their argument that any e-learning or m-learning platform is predicated on "building an online learning environment for remote collaborative learning" puts renewed emphasis on the importance of tools "improving students' interaction, engagement, and collaboration" (Al-Abri et al., 2017, p.891). Rather than looking at how students engage with e-learning or m-learning specifically, it might therefore be more appropriate to explore the ways in which such interactions are similar or different to how students already engage with social media.

Buabeng-Andoh et al. (2019) similarly address a gap in the literature particular to developing countries, which is whether e-learning and m-learning are seen as drivers for pedagogical change (e.g., Beetham & Sharpe, 2013) or if there is a greater need to integrate e-learning and m-learning with current, teacher-centred pedagogy (e.g., Iskander, 2014). The discussion in Buabeng-Andoh et al. (2019) does not engage with the question of whether Oman should be regarded as developing in terms of attitudes towards e-learning and m-learning or if the label of 'developing' should be used in a purely economic sense, so this may also be a gap which needs addressing with respect to the

particular circumstances in the Middle East of being wealthy but lagging behind in technology use.

2.14 Limitations in this review

The scope of the study focused on the need to consider peer-reviewed publications up to the year 2022 published in English and relating to Oman and some Middle East higher education institutions since Oman draws a lot of ideas from other Arab nations of the Middle East. Innovations presently being made in universities may be discussed at conferences and on blogs or Twitter without yet reaching the published literature, and so would not be included here. It may also be considered a limitation that only English-language materials have been used since many teachers in Oman may prefer to publish in Arabic, particularly if discussing works in progress rather than composing a research paper. The study also found that some studies in Oman were collaborations with academics in neighbouring countries, so there could be a justification for expanding the scope of future reviews to look beyond Oman.

Another limitation to consider concerns the feasibility and effectiveness of active learning approaches in the regions that would include Oman, in light of a possible strong resistance to change that is reported within the region's education systems (Buabeng-Andoh et al., 2019). Whilst I concede that there is some resistance derived in part from cultural and institutional factors, this does not negate or disqualify the potential positive outcomes from the implementation of technology-enhanced learning initiatives in Middle Eastern countries such as Oman. Whilst I acknowledge the barriers that challenge educational reform initiatives in the Middle East, it is also important to recognise and drive forward the agency and potential capacity of educators, students, policymakers, and other stakeholders in Oman (and the Middle East) to implement meaningful and sustainable changes.

I believe that there is transformational power to change learning practices leveraged by TEL in Oman, so that stakeholders can adopt a commitment to challenge negative and existing assumptions about limitations of active learning approaches in Oman and the Middle East. Resistance to change is not insurmountable; rather it is an important step towards a constructive approach which recognises resistance as opportunities for reflection, dialogue, and innovation. My study is tasked to contribute to a more nuanced understanding of the challenges and transformational potential of TEL in Oman and the Middle East.

This study also looked at what is being done rather than what is being proposed, so aspirational documents or policies such as those put out by government ministries or individual universities in their recruitment materials might be a helpful future source of grey literature, albeit one that is likely to be rarely available in much detail in English. In this regard, however, one of the included studies (Sarrab, Al-Shihi, Al-Manthari, et al., 2018) used a qualitative synthesis of such materials in its analysis, so the key points from a broader range of literature are at least partly represented in this study. Taking all these limitations into account, it can be argued that this review of papers nevertheless gives a comprehensive overview of recent innovations in e-learning and m-learning in Oman's higher education sector, but that the findings discussed in this chapter may be considered as the more established recent knowledge and that there are likely to be many more tentative findings to be explored and which may emerge gradually over the coming years.

CHAPTER THREE

METHODOLOGY AND METHODS

3.1 Introduction

This chapter begins by outlining the main reasons for adopting a mixed methods design, presenting an argument for how the underlying philosophical principles of mixed methods integrate with the theoretical framework established in the literature review. This is then contextualised within the specific research questions. Following an overview of ethical considerations informing the conduct of the research, the specific research tools are explained along with the main quality assurance concepts associated with each tool. These specific research tools are then integrated back into the concept of warranted assertability and how rigour is conceptualised in mixed-methods, bridging the gap from methodology through to methods and then on through analysis to claims and conclusion development.

3.2 Justification for mixed methods design

Methodology links the philosophical underpinnings of a paradigm and the methods of a particular research study, serving as an important guide to not just doing the research, but to how that research is perceived, and its conclusions are formed. As Daly puts it:

> "Methodology connotes a set of rules and procedures to guide research… that are widely known and generally adhered to… Conventions for classification and definition, deduction, induction, sampling procedures and so forth allow one to proceed systematically through the evidence... methodology provides not just a way of organising ideas and evidence but a language and format for communicating what one has found in one's research. It is in this view an

essential part of establishing legitimacy for oneself as a researcher and also for one's work" (Daly, 2011, p.192).

Thus, Daly (2011) makes a case for methodology influencing not just the design, but also the conduct and even the writing up of a thesis. Buttressing the views of Daly (2011), Creswell and Plano Clark (2018) posited that mixed method research design provides a more robust and nuanced understanding of complex phenomena, incorporating both the breadth and depth of data; for instance, a mixed method approach can enhance the validity of quantitative research results by providing additional contextual information through qualitative data. Similarly, qualitative research can be supported by quantitative data to provide a more comprehensive understanding of the research question (Creswell & Plano Clark, 2018). However, that is not to say that mixed methods research has no challenges of its own.

Some of these challenges include being resource intensive and time consuming (Bazeley & Kemp, 2012), requires expertise in both qualitative and quantitative research methods which can be demanding (Creswell & Plano Clark, 2018), combines two different data structures which may be difficult to analyse jointly (Teddlie & Tashakkori, 2009), and can be difficult to validate due to potential methodological bias (Morgan, 2014). A good example of this is the concept of validity from the quantitative paradigm, which is formed as external validity on the presumption of an external reality, truth, or falsifiable claims to knowledge. In contrast to this stands the qualitative paradigm, in which it would be more appropriate to discuss the credibility or transferability of findings than their validity (Guba & Lincoln, 1994), and it may even be claimed that the very notion of validity should be dismissed in qualitative research (Creswell & Plano Clark, 2018).

To address this issue, some authors developed new concepts appropriate to mixed methods, or even more inclusive concepts such as rigour or credibility. The best known of these is perhaps from Creswell and Plano Clark (2018, p.56), although their work on mixed methods does seem to favour quantitative values, because in their opinion, mixed methods research may not be as generalisable as quantitative research if there are small sample sizes and the focus is on specific contexts or settings. An alternative approach, coining many new terms and trying to set mixed methods apart as an approach in its own right, is offered by Plowright (2011), but these concepts have not found an extensive following to suggest that they can function as a common enough language among researchers as Daly (2011) would require of a methodology's terminology. Nevertheless, Plowright's (2011) adaptation of the positivist paradigm's concept of warranted assertability is valuable as an over-arching concept, and is returned to near the end of this chapter.

One of the first steps of justifying a mixed methods methodology is to point out where alternative methodologies would be either limited or unsuitable for the particular research question or concept. It is often straightforward to explain why a quantitative approach is not appropriate for a particular research focus, however, less so to explain why a mixed approach is preferable to a purely qualitative approach beyond simply offering extra scale. Plowright (2011) asserts that this has more to do with the anxieties of researchers than any real need to justify mixed methods as an approach, and that a researcher adopting a solely quantitative or qualitative approach would not expend the same energy on justifying their paradigms. In the same sense, conceptualising educational research as a craft as much as a science asserts that justification of the approach is less important than considering the individual tools and how the analysis fits together or how well the research is conducted, regardless of its paradigm (Symonds & Gorard, 2010).

Nevertheless, some brief justification can still be helpful given the relative novelty of the approach.

As with qualitative research, mixed methods address the interpretivist need for rich information for a broader understanding of contexts. This is borne from the inability of quantitative research to deal with "a world in which reality is socially constructed, complex, and ever changing" (Thomas, 2003, p.6). The social dimension is similarly important, with quantitative approaches limited in their ability to consider how meanings can be ascribed differently by different individuals or groups (Creswell, 2014). There is also an assumption that the context is difficult to understand, but that such understanding is worthwhile, so the researchers must learn as they go and cannot arrive in a context with ready-made data collection tools such as surveys unless they have come out of a qualitative process of "deep attentiveness, of empathetic understanding" (Punch & Oancea, 2014, p.147). The challenge with justifying mixed methods is therefore to ensure explanation not just of how such shortcomings of quantitative research are present in the context or topic of interest, but how there are also shortcomings in qualitative approaches which could be taken as an alternative.

Furthermore, it needs to be shown that these shortcomings can be mitigated through quantitative means. Perhaps the best explanation of this is to see research as multi-staged, where not just the analysis but also the collection of data and even the conceptualisation of the study as a whole follows an iterative approach (Biesta, 2012). Similarly, Yin (2009) deftly avoids the issue by conceptualising the case study as a methodology rather than a strategy, within which quantitative and qualitative tools are drawn upon for particular aspects of the case in a highly pragmatic sense. There may also be a policy context to research, meaning that a researcher adopts qualitative approaches wherever possible to gain depth of understanding, but also recognises that translating

findings into actionable policy evidence will require some element of simplification and generalisation through quantitative means (Gorard & Taylor, 2004).

All of these explanations have some bearing on the present study. Implementation of technology in terms of simple usage figures could be enlightening, but might have more to do with ease of use or straightforward efficiencies rather than what it means for a learner to truly 'use' a tool to enhance learning. It may also be that the context has some generalisable features in common with other facilities for medical education, but that this needs to be considered within a broader Middle Eastern framework. Thus, some aspects of the research may be unproblematically generalisable, others may be intensely local. Thus, the study takes Plowright's argument for mixed methods being more than method, but rather a methodology in its own right (Plowright, 2011), where the tools of research must be deployed in ways suited to the particular aspect of the research question and context of research. It is therefore the as-yet unknown influence of local context combined with the relative novelty of the new learning tools and approaches that offers the strongest rationale for a mixed methods approach in the present study.

3.3 Philosophical underpinnings

Articulating the alignment between the theoretical framework of a thesis and the philosophical foundation of a methodology, including how such a foundation manifests in methods, is argued/contended as a substantial/significant aspect of improving the rigour of a study and, moreover, something too often lacking in educational research (Jackson, 2013; Plowright, 2013). This section therefore seeks to briefly and explicitly/clearly/unequivocally address these issues, supporting the later discussion when outlining/delineating specific methods and tools of research.

As discussed in earlier chapters, the theoretical framework for this thesis is organised around theories of educational change. First, there is a need to frame the change

from teacher-centred, transmission models of education to more student-centred, constructivist models. This includes thinking of learning in a much broader sense, including students learning without a teacher, in different locations, and at different times than might have previously been considered in educational research in this context. Second is a need to conceptualise technological sense in a way which goes beyond simply seeing technology as tools for performing tasks, but which sees technology as having some agentic force and perhaps even a transformative potential (Hoban, 2002; Jackson, 2013). This helps to position pedagogical change as coming from teacher and student learning and development of new approaches, rather than the change being formulated elsewhere and then implemented in the classrooms (Hoban, 2002).

Bringing these two aspects of the theoretical framework together is to regard the site, participants, and subject of study in a way which considers pedagogical change and technological change as inhabiting the same conceptual space. Kennedy's work on teacher learning encapsulates this well, explaining how teachers learning and reflecting as part of a continual process of their development is a theoretical stance away from "the constricting nature of the standards, accountability and performance management agenda, and could arguably be categorised as a poststructuralist approach" (Kennedy, 2005, p.245). This will be most relevant in this thesis as a means to evaluate how teachers relate to technological and pedagogical change in terms of whether it is primarily seen as a transmissive change imposed from elsewhere, or an enabling and transformative opportunity to reflect on and advance practice. As such, methodological design from a post-structuralist theoretical framework is informed by concepts of "relativity, plurality, fragmentation, and anti-foundationalism" (Given, 2008, p.666).

A mixed methods design suits many of these concepts well, but there remain some philosophical conflicts since much of the transformative paradigm is strongly connected

to its origins within the qualitative paradigm, although this is changing gradually (Mackenzie & Knipe, 2006). A mixed methods design fits well with the idea of a complex research context, rejecting the positivist versus interpretivist conflict as a false dichotomy which does not reflect the nuanced reality of educational research (Plowright, 2011).

Mixed methods also recognises that there will always be a tension in data collection between representing a depth of views and representing a breadth of views, both of which will also be held in the tension between being grounded in their specific context and being linked to, or generalised beyond, other similar contexts. Technology as part of education change encapsulates many of these tensions, for instance, drawing into question what it means to 'use' a technology. Adding the transformative perspective is especially helpful here for distinguishing between uses which replicate current practice and uses which have the potential to be transformative (Munson & Thompson, 2018).

A poststructuralist perspective also sensitises the tools of data collection and approach to analysis to key issues of power as a social relational experience, experienced in a local and fragmented manner (Ball, 2012). Thus, those interpreting interviews will need to be aware of concepts such as a changeable self which is grounded in and affected by context, such as a teacher's relationship with educational technology being different, not just based on their own attitudes and experiences as learners, but on how they view their place within their current teaching context. Taken together, the mixed methods methodology can be seen to function through the transformative paradigm in order to make sense of the current research context through the theoretical framework of educational and technological change.

3.4 Population of the study

The population for this research study was drawn from the staff and students of higher education institutions in Oman. Specifically, of the over 30 higher educational

institutions in the country, the students and staff of three public universities were purposively selected for the study. However, for the purposes of this study, these three schools will remain anonymous as a number of the participants did not want their individual identities revealed or the name of their school known. These schools will be known as School A, School B, and School C. These schools were chosen because they were the most attended and they presented the least obstacles in allowing research access and in supplying the needed research data. The combined student and staff population figures for the three selected schools within the period of the research as revealed by the Oman National Centre for Statistics and Information (NCSI) are 57,871 and 1,210 respectively. Table 3.1 presents details of the population strata for the selected schools.

Table 3.1: Profile of Schools Used for the Study

S/N	Name of School	Student Population	Teacher Population	Student Staff Ratio
1	**School A** Highest student population of 15,357 with 49% male and 51% female	14,974	360	42:1
2	**School B** Combined population of a little over 46,000 made up of 52% males and 48% females	36,959	710	52:1
3	**School C** Combined population as of 2019 was 5,938 with 34% male and 66% female	5,938	200	30:1
	TOTAL	57,871	1,270	

Source: Oman National Centre for Statistics and Information (2021)

3.5 Sample size and sampling technique.

The sample size of 178 students was determined using the Taro Yamane sample size formula thus stated:

$$n = N / (1 + N(e^2))$$

Where:

n = the required sample size

N = the population size

e = the maximum error level or significant level desired.

(Yamane, 1967)

Therefore, the sample size of students required for this study, given a maximum error or significant level of 7.5% and a sample population of 57,871 students from the three universities selected for the study, is:

$$\text{Students' sample size} = 57{,}871 / (1 + (57{,}871 \times 0.075^2))$$

$$= 57{,}871 / 326.524375$$

$$= 178 \text{ approximately}$$

The sample size of 37 teachers was determined purposively using willingness to participate as the key criterion to select teacher participants in the research, as most teachers approached emphatically declined to participate in the survey for personal reasons.

The study employed the stratified random sampling technique which divided the students' catchment areas into strata according to school, course group, and class level. The participants were then picked at random in each stratum. Table 3.2 gives more details.

Table 3.2: Stratified random sample outcome

School	Teachers	Students' Course Group	Class Level	Number Selected
School A	4	Business and Social Sciences (24)	4th Year	16
			3rd Year	8
	5	General Sciences (14)	4th Year	8
			3rd Year	6
	2	Nursing and Medical Sciences (8)	4th Year	4
			3rd Year	4
School B	11	Business and Social Sciences (60)	4th Year	33
			3rd Year	27
	5	General Sciences (40)	4th Year	20
			3rd Year	20

School	Teachers	Students' Course Group	Class Level	Number Selected
	4	Nursing and Medical Sciences (14)	4th Year	8
			3rd Year	6
School C	3	Business and Social Sciences (8)	4th Year	4
			3rd Year	4
	3	General Sciences (10)	4th Year	6
			3rd Year	4
	0	Nursing and Medical Sciences	4th Year	0
			3rd Year	0
TOTALS - **Teachers**	**37**	**Students**		**178**

Source: Researcher's Data Analysis (2021)

3.6 Instruments for data collection

The data collection process for this research study was executed using three questionnaire instruments. Two of the questionnaires were structured to limit the responses of the respondents within designated options. The first questionnaire containing

51 structured twin questions for the 2019 and for the 2021 periods was designed to elicit responses from students, whilst the second questionnaire containing twelve structured twin questions for the 2019 and the 2021 periods was intended to collect the responses of the teachers. The third questionnaire contained 21 open questions intended to attempt to gauge the perceptions of the teachers involved in the study. The three questionnaires were validated through desk check and peer review for completeness and correctness, while they were also further subjected to a test-retest analysis using ten students and two teachers as a pilot scheme. The results for the test-retest exercise were analysed with an ICC test which returned values (closer to 1) of Scale A: = 0.85, Scale B: = 0.78, and Scale C: = 0.92 for the teachers' structured, students' structured, and teachers' open questionnaires, respectively, thereby indicating that the data collection questionnaire instruments had high test-retest reliability and were able to measure what they were intended to measure.

3.6.1 Instrument construction

The instrument was designed around alignment of the research questions and the study objectives, pertaining to the investigation of benefits, potentialities, possibilities, and new opportunities that could be inherent in online and other non-conventional technology-based distance learning systems and could be useful for Omani students. The process involved several key steps, which included conceptualisation and validation to ensure instrument reliability and validity.

First, I constructed the instrument by conceptualising what key variables and constructs needed to be measured; these were informed by the research questions and relevant literature. This process was conducted by considering the context of technology-enhanced learning in Oman and the Middle East. Moreover, the specific study objectives

to investigate students' and teachers' perceptions and their usage of technology for the purposes of learning and teaching were also factored into the instrument design process.

Next, as is common in mixed methods research, I constructed both structured and open-ended questions in the questionnaires. Structured (closed) questions were designed to be answered by Likert-scale responses to quantitatively measure participant perceptions and behaviours; this facilitated the ability to conduct statistical analysis and comparison over a period of time. Open-ended questions were constructed to capture qualitative participant perspectives, creating an interview setting to elicit richer contextual understanding, to contribute to and complement the quantitative data. Desk checks and peer reviews enabled instrument validation to ensure question response completeness, clarity, and appropriateness, including solicitation of feedback from university faculty and peers as a means to attenuate potential ambiguities or biases in question design.

Finally, the SPSS test-retest analysis was supplemented with an Intraclass Correlation Coefficient (ICC) analysis which indicated stability across all the questionnaires. Ethical considerations were in place to ensure that participants' rights and confidentiality were protected throughout the data collection process and informed consent procedures were in place so that participants could terminate their participation without offering any rationale. (The final instrument is presented in Appendix C.)

3.6.2 Methods of data analysis

By design, the main type of data collected for the execution of this research study was qualitative in nature. However, due to the need to statistically compare the results of the survey for 2019 and that of 2021, two of the questionnaires were structured to produce Likert-scale numeric values, while the third questionnaire was open to enable the teachers to state their responses freely.

The data collected using structured questionnaires were converted to numerical values using Likert-scales ranging between a minimum of 3 and a maximum of 7. The numbers were then grossed and averaged for each of the two periods (2019 and 2021), then passed through the repeated measures analysis of variances (ANOVA) tests and additional post hoc data sensitivity and sphericity tests. The results of these tests were then subjected to two major hypothetical tests to determine how significant the difference between perceptions were (if any) between the two periods of 2019 and 2021 at a 5% significant level.

The data collected with the open questions posed to the teacher-respondents were subjected to thematic analysis with the aid of codes generated using Microsoft Excel software. The themes covered effects of change, affordability of gadgets, government and institutional support, willingness to adapt to new teaching methods, availability of wireless networks inside the campus, availability of wireless networks outside the campus, impact on teaching methods, and students' performance improvement.

3.6.3 Data analysis reliability

The reliability of the data collection was primarily assessed via Cronbach's alpha coefficient, which measures internal consistency as opposed to test-retest reliability (Kennedy, 2005). I used Cronbach's alpha to assess reliability for every questionnaire instrument, that each scale item was measured with the same construct consistency. High values of Cronbach's alpha served to indicate greater internal consistency, and this indicated that these items were reliable in providing responses to the intended construct. In addition, I also conducted an ICC test-retest analysis to validate the stability of responses over a period of time. The questionnaire instruments were administered to participant subsets twice, at different times, to measure the correlation between their responses. While Cronbach's alpha provided insight into the scales' internal consistency,

the ICC test-retest analysis helped understand the responses' stability over a period of time. This approach contributed to the research findings' overall reliability.

3.7 Links to research questions

As noted in Chapter one, the research questions are:

What forms of technology do the students use for learning inside/outside the classroom and for social interaction in Oman and how has this usage changed since technology first started to be used as a teaching tool in Oman in 2001, and particularly between 2019 and 2021?

Do teachers use different forms of technology for different purposes? How does this impact on teaching and learning in HE? To what extent have teachers embraced the changes in technology since they were first introduced in Oman in 2001, and particularly between 2019 and 2021?

RQ1. What are the perceptions of Omani HE students and teachers about using technology for learning and teaching inside and outside the classroom?

RQ2. How have changes in technology, in particular mobile devices or e-learning, impacted these perceptions?

Questions 1 and 2 are philosophically undemanding in a quantitative sense, in terms of which tools are used when and for what; but a broader concept of use (particularly when using a comparison over time) adds in the qualitative sense where it is important to draw out what each individual means by using (or not using) technology in their context. Question 3 is much more qualitative in nature, focusing on perceptions and what might have impacted on perceptions. This relies on self-reporting and drawing out what might be tacit beliefs and values, but some context from the quantitative data on forms and purposes of technology use may be helpful in probing for greater depth during this process. As such, the research tools are divided between mainly quantitative data for

the first two questions and mainly qualitative data for the third question. This involved a survey of 178 students drawn from the institutions mentioned in Section 3.6. Respondents were also invited to participate in follow-up interviews, with the intention being to interview as many as 30 of these. These tools, and the issues around their creation and use, are expanded upon more fully in Section 3.9, but first I will consider how ethical practice was affected by the research context.

3.8 Ethical foundations

Hays and Singh (2012, p.68) define ethics as "a set of guidelines established within a professional discipline to guide thinking and behavior" (p.68). This is of particular importance with mixed methods research where the richness of data can raise some ethical issues. For instance, a quantitative survey might only ask for minimal personal information in order to respect anonymity, only collect relevant data, and help participants feel comfortable responding, but more details might be desired in a qualitative or narrative approach where the story and biography of a participant matter. Regularly revisiting the ethics of a study during design and collection is therefore important in terms of a study's integrity (Bryman, 2016), with a need to be aware of changes in topic, context, nature of participants, or surprises in data collection or analysis (Punch & Oancea, 2014).

Webster et al. (2014, p.78) outlined five widely-adopted principles of ethical research. These assert that research should:

- Be worthwhile for participants and make reasonable demands of them.
- Ensure informed consent.
- Avoid pressuring participants, guaranteeing that participation is entirely voluntary.
- Try to avoid risks or adverse consequences.

- Respect participant anonymity and confidentiality.

First, being worthwhile means conducting a comprehensive literature review to be confident that the issue has not already been sufficiently covered elsewhere. In this respect, the use of e-learning tools in a medical, academic, and societal context in the Middle East is novel. As was discussed in earlier Chapters 1 and 2, different attitudes to the Internet in the Middle East can be expected to influence uptake of digital tools and so represents a relatively unusual situation worthy of focus. Informed consent is relatively straightforward for the quantitative survey by including information sheets and questions for respondents to tick to show they have understood the information and are happy to proceed. However, quantitative tools are much more sensitive to priming effects and so generally it is advisable to try to give participants less detailed information to avoid influencing responses through issues such as social desirability bias. The same potential for bias exists in qualitative data, and perhaps more so due to the personal interaction in interviews, but there is a need to give participants more information because an interview demands more participant involvement. This is not just in terms of time, although this is important for respecting the 'gift' of data (Bell & Waters, 2014), but to give participants a chance to think about some of the topics in advance so that they can say what they want to get across.

A related issue, third on the list, is to ensure that participants can freely withdraw. Again, this is easier on a survey where participants can simply stop. In an interview situation, there may be some social pressure to continue. Here, the experience of the interviewer is important, to be sensitive to any discomfort of the participant. Using a semi-structured format is also useful for sticking to topic and time, helping to avoid the risk of the interview losing focus from what the participant originally agreed to. A structured

format can also build in breaks or other opportunities to check that a participant is happy to continue, while member checking afterwards provides a further opportunity from a distance for participants to check that they are happy with how they have been represented and that they are still comfortable for their data to be used (Wengraf, 2001).

The precautions for points 1 to 3 can also support ethical practice for points 4 and 5, giving participants time and space to reflect on their participation and make positive choices. These points are further enhanced by data security processes, ensuring that data are securely stored and encrypted, kept only for the amount of time specified, and used only for the purpose specified. In the context of recent changes such as the General Data Protection Regulation (GDPR) (Regulation, 2018), it is reasonable to expect that participants will want to be assured of how their data will be used and stored, and that they will be asked to give active consent rather than consent being assumed. These issues also extend into reporting, since research theses are usually available publicly.

Quantitative data can be anonymised easily since responses are aggregated and removed from context, in this case with around 300 responses presented at once. For qualitative data, some background or biographical information might be deemed useful. Here the challenge is to represent the original context and manner of speech in ways which help readers to understand the issue without revealing anything idiosyncratic enough that someone could be identified. In small learner communities, this could be a risk. Offering the participants the opportunity to review and redact their information is one solution, although this may place a burden of work on participants. Alternatively, only salient information might be included and thesis supervisors could be asked for advice in how to communicate findings through direct quotation. Similarly, guidance can be taken from well-formulated ethical role models identified during the literature review.

Finally, keeping/retaining an accurate record is important for making effective use of the data. Participants will be asked for their permission to audio record the interviews. This facilitates the flow of the interview by removing the need to take notes, and so "allows full attention to be devoted to listening and responsive questioning, to thinking about how the interviewee is approaching the discussion and responding to the question. It provides an accurate, verbatim account of what was said, capturing the language used including hesitations and pauses… in far more detail than would ever be possible with note-taking" (Arthur, Mitchell, Lewis, & Nicholls, 2014, p.172). Consent to recording will also be confirmed verbally at the start of each interview as well as repeating that participation is voluntary, including allowing recording, and participants may withdraw at any point and without giving a reason, as per Gray (2014), who states that a researcher must ensure that the participants do not feel obligated to participate or give any specific permission.

3.9 From methodology to methods

At the most basic level, methods can be thought of as highly pragmatic tools employed for a particular purpose. Thus, methods are simply the equivalent of a microscope when used by a scientist, a thermometer when used by a medic, or a telescope when used by an astronomer. "They do a job" (Denscombe, 2014, p.3). However, as was discussed in Section 3.1, in terms of research paradigms, there are common associations between method and methodology which make method choices more complex than Denscombe's explanation might suggest. For instance, it is relatively uncontroversial for Punch and Oancea (2014) to describe interviews as one of the most popular tools in qualitative educational research. However, there remains significant "diversity in both the design and use of the research instrument and in the nature of responses from participants" (Bush, 2012, p.78).

In a mixed methods approach, one research method may generate data of different types. This is partly the reason why Plowright (2011) prefers to talk about data as narrative or numerical rather than qualitative or quantitative. In discussing the particular methods used in the following two sections, it should therefore be remembered that while the survey is more quantitative and the interview more qualitative, the combination of data in analysis and discussion will need to transcend these boundaries, and this is discussed in section 3.12 of this chapter.

3.10 Quantitative methods

Ensuring the quality of quantitative research is centred on design and analysis, with there being very little that a researcher can do once data collection is underway. This is in contrast to the flexibility of qualitative interviewing, where questions can be changed during an interview or themes developed with one participant, explored with subsequent participants. Quantitative tools do not have this flexibility, and with anonymity there may only be one opportunity to ask a question. One simple check is therefore that the language of questions is understandable, relatable, leaves no room for misinterpretation, and produces meaningful answers that can be interpreted confidently by the researcher. Straightforward ways to address this are to avoid leading questions, having questions with more than one point, or having quantities in rating items (Fink, 2015). Similarly, there are simple design tips such as occasionally reversing the sentiment of questions (i.e., so not all questions have 'agree' as the positive response) to avoid participants becoming bored and completing the survey on 'auto-pilot' (Yorke, 2009).

Design also needs to take account of how questionnaire data will be used. One common error is to ask questions without considering how they relate to each other. As a result, data can only be considered one question at a time, which limits analysis to only considering ordinal variables through descriptive statistics. Instead, planning related

groups of questions to create pseudo-continuous variables enables the use of inferential statistics. This is known as the "problem of equal intervals", which creates "illegitimate inferences" (Cohen, Manion, & Morrison, 2013, p.327) that, for example, the difference between strongly agree and agree can be treated as equal to the difference between agree and neutral. This is effectively what happens when the labels are treated as numbers (so strongly agree becomes 5, which is one more than agree at 4; a difference equal to agree at 4 and neutral at 3).

Boone and Boone (2012) give a plausible explanation of how this problem impacts on analysis, pointing out that what many researchers refer to as Likert scales are actually just adjectival rating scales. The distinction here is that an adjectival rating scale is an ordinal value made up of a small number of responses (typically 4, 5, or 7). It is only by combining several of these together through a mean that the range of possible responses can be increased, meaning that the problem of changing a word to a number remains but is essentially diluted by averaging out somewhere between 4 and 7 of such comparisons. As was advocated by Likert himself, the resultant Likert-scale should be treated as a latent variable of sufficient range to be considered continuous and, therefore, suitable for use in a much wider range of inferential statistics (Boone & Boone, 2012). Such related items can be taken from existing surveys and simply checked through reliability testing, such as Cronbach's alpha, or derived fresh for the particular research study through exploratory factor analysis (Field, 2009).

More generally, quantitative tools must be designed to consider issues of validity and reliability. While there are many different types of validity to consider, the key point is that the questions measure what they claim to measure (Cohen et al., 2013). Reliability measures or factor analysis help with this, suggesting where individual items can combine to indicate latent variables, although it is still down to the interpretation of the researcher

to label such variables and so assign them meaning. There are also straightforward ways to improve validity, such as ensuring that questions are meaningful and have been interpreted correctly. As well as conscientious construction of the survey tool, this is enhanced through mixed methods approaches where interview discussions can be used to illuminate observations from the quantitative data (Yorke, 2009).

3.11 Qualitative methods

Qualitative or narrative data in this study are generated through the semi-structured interview. As a general description, Kvale (2008, p.14) explains how an interview is "an interchange of views between two or more people on a topic of mutual interest". It is this interaction which plays the important role in knowledge production, which is why data are referred to as generated rather than discovered. The communicative interaction is also emphasised by the need to consider interview data as multi-sensory, paying attention not just to what is said but what is heard or what is tacitly communicated (Cohen et al., 2013). Thus, the way of speaking could be regarded as data separate from what is said, as can other interactional features, such as the way that turn-taking is handled or the movement between topics. In more structured interviews, this is brought more under the control of the interviewer "while still giving space for spontaneity, and the interviewer can press not only for complete answers but also for responses about complex and deep issues" (Cohen et al., 2013, p.349). Wengraf likewise highlights that the way an interviewee responds to this structure can itself be of interest if the biography of the participant is a focus; an example he gives being an interviewee who keeps moving the topic away from discussing their father (Wengraf, 2001).

In this thesis, such personal biography is not deemed relevant. As a way to avoid being too intrusive, and limiting the extent to which data are mined for interesting but perhaps less relevant nuance, the interview is conceived at the more structured end of the

spectrum. The term semi-structured has become somewhat overused and has broadened to encompass almost all types of interviews (Creswell & Creswell, 2018). Nevertheless, the label suits the interview approach in this study in which:

> The use of questions is reserved for the start of the interview and the moments when, in view of the time and the plan of the interview, the interviewer thinks it is important to move on. Such an interview is called 'semi-structured' because the basic scaffolding that fills out the allotted time is set up in advance... In general, the semi-structured interview is a more systematic and slightly more pre-planned method than the unstructured interview. (Olsen, 2012, p.34)

In contrast, a fully-structured interview would be more akin to talking an interviewee through a survey tool. This would not be a suitable description for the interview design in this thesis because there is still flexibility to deal with changes or issues as they arise (Dawson, 2007). This means that attention must be paid not just to the questions that are asked, but also how a trust is built between interviewer and interviewee, the ways in which questions are asked and answers listened to, and how points are followed up in probing yet sensitive ways. However, the topic is still highly focused and asks about specific uses of specific tools, and so does not wish to invite too many completely open or unstructured responses so that responses from participants can be more easily compared.

The issue of comparability and the choice to have a more structured interview reflects the balancing of different conceptualisations of rigour relevant to the mixed methods methodology. Qualitative approaches would be more focused upon representativeness than generalisability, so it is not necessarily desirable to compare responses in terms of how many said what. For instance, even saying that 'most' participants expressed a similar view could be interpreted as a quasi-statistic which serves

to slightly undermine the point that qualitative data are emphatically not about generalisations and "counting responses misses the point of qualitative research" (Pyett, 2003, p.1174).

However, this is a rather strong form of conceptualising qualitative research, and mixed methods need not feel so constrained (Creswell & Creswell, 2018). Mixed methods draw upon numerical and narrative data, using a range of data types to look at research questions from different perspectives, so whether it is appropriate to say '80% of interviews mentioned x' or 'most interviewees agreed that' is more to do with the research question than it is the paradigm from which the research tool is drawn.

Quantitative studies rely on a sufficient sample size to suggest that any minor differences essentially average out across a sample, creating a generalisable consensus. Qualitative studies are more interested in these differences, so would not want to average them out even if this were possible. Moreover, qualitative studies deal with richness of data, so are necessarily smaller scale given the same resources. Representativeness is therefore a more relevant concept than generalisability, asking whether a sample represents a broad enough range of views for the context under study (Given, 2008). Quantitative studies can establish this by setting sample size requirements related to the estimated population size or the requirements of particular statistical tests (Field, 2009).

Representativeness also needs to be considered where there is a broad invitation for volunteers. Qualitative studies can struggle to find sufficient numbers of volunteers, leading to the concern that more extreme views are represented – volunteers are those with something they want to say, either strongly negative or strongly positive (Robinson, 2014). However, this can vary by context. In healthcare research, for instance, a culture of mentoring and support has been attributed to the phenomenon of very high engagement with and volunteering for research studies (Price, Biswas, & Biswas, 2014). Thus,

representativeness cannot be determined through sampling alone but has to be considered throughout the analysis, possibly with further sampling used if deemed necessary. The key concept here is saturation (Charmaz & Belgrave, 2012), where coding of interviews is initially performed one interview at a time. As each interview is analysed, the number of codes re-used from previous interviews should decrease.

Eventually, depending on the range of views on a particular topic for a given context, this will reach the point where no new major themes are generated through initial coding. At this point, researchers can either stop analysis and deem saturation to have been reached or, if there are still data to be analysed, code one more interview just to be sure. Saturation emphasises the importance of not collecting too much data before analysis begins, since some of the data might not be necessary, although there are practicalities of access which can mitigate such an iterative approach. Nevertheless, it can be argued that representativeness grounded in the topic and context is a more suitable concept for the interview stage than generalisability, and that judgements regarding the representativeness of the data are made during analysis and not just at the point of data collection.

The role of the researcher in generating the data during interviews also gives rise to concepts of trustworthiness and transparency, which are loosely equivalent to the validity and reliability checks for quantitative measures (Field, 2009). Questions may be asked in slightly different ways depending on responses to previous questions, so the validity and understandability of questions cannot be standardised in the same way as a survey tool might attempt. However, the interactional nature of an interview gives some reassurance that such changes are simply to help communication, and readers are somewhat required to trust the competency of the interviewee. Training in interview methods is therefore part of the quality control of qualitative interviews, and this can be

supported by practicing transparency, such as keeping audio recordings or interview notes which allow someone else, such as a supervisor, to check the way that questions were phrased and how interactions were managed.

This relates closely to the concept of a qualitative study being auditable, with enough detail given in recruitment and conduct of the research that another researcher could replicate the study and hope to get similar results. However, this is negated by a social constructivist view where meaning is bound in the here-and-now of research, calling into question the very notion of replicability. As such, conscientious record-keeping and being mindful of potential sources of researcher bias are perhaps the best that can be realistically employed in ensuring the rigour of interview data collection (Charmaz & Belgrave, 2012).

In summary, this section and the previous one have both argued for the quality of data generation through the specific research tools of this study. However, this is only one measure of quality and is restricted to how data are uncovered or generated and then analysed. A mixed methods design demands more than this, since different data types are used for theory-building and forming of conclusions. Therefore, it is important to consider quality beyond the data collection and analysis stage and to briefly outline concepts of overall study quality which are specific to a mixed methods methodology. This is addressed in the following section.

3.12 Aligning with the values of mixed methods

Given how closely mixed methods is aligned with the interpretivist paradigm, it is perhaps surprising that Plowright borrows from the positivist paradigm concept of warranted assertability (Dewey, 1941) as a foundation for adapting his overarching framework for ensuring rigour in mixed methods research (Plowright, 2011). For Plowright, warranted assertability encompasses all the quality control and transparent

reporting that goes into explaining how different tools, data, and analytical techniques were combined in a particular study, thus creating a rich description of the "warrant, qualifying conditions and backing conditions" of claims (Plowright, 2011, p.138). This bridges across to some of the techniques commonly found in grounded theory, where claims are not just supported or advanced but alternative interpretations and claims are rigorously tested and then demonstrably refuted (Charmaz, 2014).

Asserting the warranted assertability of a claim and rebutting alternative interpretations thus creates the conditions for a conclusion which is supported by interrogation of the integrated data. Contributions from concepts such as validity, reliability, trustworthiness, or transparency are therefore placed within the over-arching framework of warranted assertability: quality and rigour are not located just in the tools or their use, but are demonstrated in how these tools contribute to an integrated analysis and well-grounded conclusion.

Finally, subscribing to mixed methods as a methodology suitable for a particular research problem in a particular context means being clear about the kinds of knowledge claims that can be made. As was argued earlier, the theoretical framework for this study locates it within a transformative paradigm. Rather than articulating a specific ontology or epistemology, it has been argued that mixed methods is a suitable framework for the research context. This goes against tradition in qualitative research, with Plowright noting how the relationship between philosophy and methodology in mixed methods is "the other way round [from traditional research methodologies]: methodology determines the philosophy you might employ to explain your approach to undertaking research" (Plowright, 2011, p.181).

Thus, it is important to acknowledge the philosophical limitations of claims and conclusions which can be derived using this methodology. Specifically, mixed methods

subscribe to "holistic integrationism… [comprising], a pragmatic integrated methodology, a relativist social epistemology, a realist social ontology, [and], a realist object ontology" (Plowright, 2011, p.184). To put this into the context of the current study, claims will rely on a coherent narrative across the different types of data and methods of analysis and not privilege one type of data over another, and appreciation of nuance and situated reality of the here-and-now is balanced against an acceptance that the findings of this particular study could be more broadly applicable to other similar contexts, but that this might not be necessarily so.

3.13 Summary

This chapter has outlined the methodology and methods of this thesis. Where possible, philosophical assumptions and methodological conventions have been made explicit so that an argument can be made for the consistency and suitability of the methods employed in this study and their alignment to a mixed methods methodology. As such, the thesis as a whole has positioned itself within the transformative paradigm of educational research based upon the theoretical framework previously articulated in the literature review in Chapter 2. Concepts of rigour relevant to the particular tools of research have been explained in terms of tool design and data analysis intentions, demonstrating that the methodology is thoughtfully designed with regard to the notions of quality relevant in both the quantitative and qualitative traditions. Finally, the chapter has shown where these notions of quality may be in tension when the numerical and narrative data are brought together. Here, the work of Biesta and Plowright (2018) was used to navigate these tensions and thinking of the iterative processes by which narrative and numerical data can connect to generate meaning. This combines with the ever-present ethical considerations outlined in this chapter to give structure and context to the data analysis and discussion which follows.

CHAPTER FOUR

FINDINGS

Two outcomes of doctoral research work lies in its results and findings. In this chapter, the findings as gleaned and interpreted from the results of data analysis are also presented.

4.1 Research focus and type

This research study focused on validating the merit or demerit of the wave of change from teacher-centred, transmission models of education in Omani higher educational institutions to more student-centred, constructivist models. The study used a mixed-method design to carry out the investigation in order to avoid an alternative methodology that would be limited or unsuitable to address a particular research question (Plowright, 2011).

The study adopted the mixed methods approach particularly, because, from the three major research questions that guided the study, two were better suited for qualitative replies as the third gauged differences in the perception of respondents between two time periods, which necessitated a statistical evaluation to know whether there were significant differences in the two periods' perceptions. Again, the social nature of the research construct necessitated a mixed method because, in qualitative research, mixed methods address the interpretivist need for rich information for a broader understanding of contexts due to the stated inability of quantitative research to deal with "a world in which reality is socially constructed, complex, and ever changing" (Thomas, 2003, p.13).

4.2 Research questions and study execution

This study was executed, guided by the following research questions:

1. What forms of technology do the students use for learning inside/outside the classroom and for social interaction in Omani and how has this usage changed

since technology first started to be used as a teaching tool in Oman in 2001, and particularly between 2019 and 2021?

2. Do teachers use different forms of technology for different purposes? How does this impact on teaching and learning in HE? To what extent have teachers embraced the changes in technology since it was first introduced in Oman in 2001, and particularly between 2019 and 2021?
3. What are the perceptions of Omani HE students and teachers about using technology for learning and teaching inside and outside the classroom? How have changes in technology, particularly mobile devices or e-learning, impacted these perceptions?

The three research questions are interrelated; however, Questions 1 and 2 are philosophically undemanding in a quantitative sense because they were built to elicit qualitative answers from respondents over two different periods and the answers converted to numeric values via a Likert-scale conversion process for the purpose of statistical comparison. This then necessitated the use of 63 questions spread across two questionnaires (see Appendix A) that were designed and duplicated, one for student-respondents numbering 178 and the other for 37 teacher-respondents. The major aspects of the first 63 questions were structured in line with a modified Likert scale with options ranging between three (minimum) and seven (maximum). Evidence to address Research Question 3 was gathered using a specifically designed teacher-respondents' questionnaire (see Appendix A) containing 21 open-questions which allowed the teachers to comment freely on their perceptions and convictions on the use of technology.

4.3 Evaluating the responses

The responses to the questionnaire questions were collated and analysed according to the nature of their responses. The 21 teacher-respondents' open questions

were thematically evaluated whilst the 63 structured questions collected over a two-year time period interval were quantified and evaluated in accordance with the Likert scale attached to each and analysed using repeated measures analysis of variances (ANOVA) tests. The repeated measures ANOVA tests are used when there is the need to know if there are significant differences between measures or perceptions observed at different time intervals on the same subject matter (Hinton, Brownlow, & McMurray, 2004).

4.3.1 Thematic evaluation of responses to teacher-respondents' open questions

In this sub-section, the open questions posed to respondents and their responses are set out in order. The questions were subjected to thematic analysis with the aid of codes generated with MS Excel software. The themes covered effects of change, affordability of gadgets, government and institutional support, willingness to adapt to new teaching methods, availability of wireless networks inside the campus, availability of wireless networks outside the campus, impact on teaching methods, and students' performance improvement.

TOQ1 - How would you explain your own teaching pedagogy (from experience in teaching higher education, your methods and preferred style of teaching)?

Result: This question was posed to elicit answers from the teachers surveyed about their own individual experiences of pedagogy. Sixteen of the 37 teachers or 43.2% of respondents reasoned that the quality of their teaching pedagogy was significant, due to constant training and students' interactive experiences. Twenty-seven percent were of the view that their pedagogy was still growing, while 18.9% scored themselves low on pedagogy in terms of lack of adequate pedagogical skills, and as many as 10.3% were not sure where they could place their level of pedagogy.

TOQ2 - What is your view on the use of technology as a source of teaching? (Do you support the idea of technology integration with classroom teaching? Why or why not?)

Result: This question was posed to know how the teachers surveyed welcomed the idea of integrating technology into classroom teaching. As many as 31 of the 37 teachers or 83.8% of respondents expressed their happiness and acceptance of integrating technology into classroom teaching because it was stated that it enhanced their work and reduced their workload, while six or 16.2% were not sure of their position on that aspect because they were yet to be fully involved. Nevertheless, no one rejected the idea outright.

TOQ3 - How do you reflect on the integration of technology (mobile devices or wireless networking) in the Oman education sector between 2019 and 2021? How has this affected your way of teaching? Does it help you in delivering knowledge in the same or any better way or does it offer more constraints than benefits?

Result: This question was posed to know how the integration of technology had affected the teachers' ways of teaching. Only eleven of the 37 teachers, or less than 30% of respondents, opined that the development had impacted very positively on the way they taught. A lower number of respondents (7 out of 37 or 18.9%) reasoned that it impacted them positively in some way, while 10 or 27% were of the view that it had little impact on their way of teaching. However, two or 5.4% reported no impact at all, while another seven or 18.9% had no idea.

TOQ4 - What are your views on the flexibility web learning offers and use of blended learning for facilitating flexible education for students? Can it deliver the same benefits as in class teaching?

Result: This question was posed to gather the views of the teachers on the usefulness and acceptance of blended learning as a way of offering a flexible learning

platform for students, and whether such flexibility can deliver the same benefits as physical classroom teaching. Thirteen of the 37 teachers comprising 35.1% said blended learning was useful and could deliver the same benefits of a physical classroom if properly implemented. Seven of the teachers (18.9%) said it was in some way useful and could deliver the same benefits as a physical classroom with caution, while four or 10.8% of teachers interviewed said it could not. A large proportion comprising thirteen or 35.1% of the teachers said they had no idea.

TOQ5 - Do you think use of mobile devices in teaching can enhance student learning? Why do you think so (or not)?

Result: This question was meant to induce teachers' opinions on how useful the introduction of mobile devices in teaching was and how such action impacts on the students' learning. A high number (27 of the 37 teachers or 73%) reasoned that the use of mobile devices in teaching had indeed enhanced students' learning because it provided the students with flexibility in time and resource sharing. Two teachers or 5.4% of the teachers surveyed were not sure, while five or 13.5% said the use of mobile devices in teaching cannot enhance students' learning due to a slow pace of technology adaptation, and the remaining three or 8.1% were unable to provide an answer because they were not yet involved in technology-based teaching.

TOQ6 - Do you think mobility, access, and immediacy are better addressed by using mobile devices in teaching methods? If so, please explain.

Result: This question was posed to know whether mobile devices could impact on the mobility and timely access to learning resources when they are integrated into classroom teaching. A good number (26 of the 37 teachers or 70.3%) said yes because of the ability to surmount the barriers of distance and storage, two teachers or 5.4% were not sure for lack of proper understanding, six teachers or 16.2% did not believe it could

due to the current low level of infrastructure, while three or 8.1% said they did not know but provided no reason.

TOQ7 - Do you think the educational context and the ubiquity of mobile devices work well together in providing an enhanced learning experience? If so, please give your reasons.

Result: For this question, twenty of the 37 teachers or 54.1% of respondents said they were sure that the educational context and the ubiquity of mobile devices worked well together in providing an enhanced learning experience because they found it much easier to collaborate and share ideas in less time, but seven or 18.9% were not sure as they were yet to evaluate that, and six or 16.2% opined that they did not, while four or 10.8% had no idea.

TOQ8 - Do you think videos, images, and graphics are viewed best via mobile devices in an HE setting? If so, how?

Result: For this question, there was equal division of opinion between those who reasoned that videos, images, and graphics were viewed best via mobile devices in an HE setting and those who did not believe so. While the protagonists who said YES comprised of sixteen of the 37 or 43.2% of respondents, the antagonists who said NO were also sixteen or 43.2%; the remaining five or 13.5% had no idea. The protagonists, however, were unable to provide other reasons than improvement in graphics image technology for their answer.

TOQ9 - Do you think communication is best and uninterrupted when mobile devices are used for teaching purposes?

Result: This question posed a little problem for the respondents. Only fourteen of the 37 teachers or 37.8% of the respondents reasoned that communication is best and uninterrupted when mobile devices were used for teaching purposes. Respondents

comprising two teachers or 5.4% had no idea because they were not involved in technology-based teaching, while a large number of 21 teachers or 56.8% said emphatically no because of some unforeseen infrastructural problems which were sometimes experienced under a strict online regime. This implies that there is no guarantee that communication will be uninterrupted when mobile devices are used for teaching purposes.

TOQ10 - What are the different sources of technology available for you to use in and outside classroom teaching? Do you favour one over the other? And if so, why? (- about the nature of sources like web learning, distant learning and wireless networking).

Result: This question was posed to identify the different sources of technology available for the use of the teachers in Omani higher institutions in and outside classroom teaching. Four major groups were identified: five of the 37 teachers or 13.5% of respondents indicated wireless networks; fifteen teachers or 40.5% mentioned multiple sources such as laptops, smartboards, Zoom, Google Classroom, etc.; four or 10.8% indicated mobile telephones and other devices such as iPod, iPad, etc. Web learning (e-learning) integrated with use of software such as Moodle, Kahoot, etc., was mentioned by eight or 21.6% of the respondents, while five others said they used none. Some teachers favoured multiple sources such as the use of laptops, smartboards, Zoom, and Google Classroom while others favoured web learning and the use of iPods, iPads and other mobile devices because of their ease of use. However, the major factor affecting the choice of any source rested heavily on the availability of institutional support and infrastructure.

TOQ11 - How would you explain the use of web learning for educating students? Can this web learning replace the classroom education in coming years?

Result: This question was posed to know if web learning was considered beneficial to students and whether it had the potency to replace classroom teaching in the future. The responses of the teachers suggested that only 8 of the 37 or 21.6% of teachers believed that the use of web learning would be beneficial for teaching students especially as the education pedagogy paradigm was gradually shifting to virtual classrooms. However, 23 or 62.2% of the teachers doubted the feasibility of using web learning to educate students due to the slow pace of technology integration in education. They confirmed the present outlook as only eight or 21.6% agreed that web learning could replace classroom education in coming years, three or 8.1% were less optimistic, while a large number of 23 or 62.2% opined that it could not. Those who had no idea comprised three or 8.1% of respondents. All respondents, however, agreed that web learning was beneficial to students especially during the pandemic.

TOQ12 - How have you developed the expertise to use technology in teaching? Are you offered any teacher-training for developing expertise to use technology in and outside class to support your teaching? How do you reflect on the current support provided by the Oman government in enabling the use of technology in higher education?

Result: This question asked the teachers to show how they developed their technology use expertise. As many as 20 of the 37 teachers or 54.1% of respondents said they were offered training by their institution and that enabled them to acquire or develop the necessary expertise, four or 10.8% said they gained their proficiency training in some way, one teacher or 2.7% said they were still expecting training, while nine or 24.3% said they received none. The remaining three, or 8.1% said they were not involved. As many as 25 or 67.6% of teachers opined that the Oman government is not doing enough to support the use of technology in higher education when compared to countries such as

the United Arab Emirates where there are other vital supportive infrastructure which were not yet in place. Only 12 or 32.4% agreed that the Oman government has done enough to support the use of technology in higher education.

TOQ13 – How do your students respond to the integration of technology in their learning? Have you seen any difference in performance of students due to change of teaching medium between 2019 and 2021?

Result: These questions sought to know the effects of technology integration on the performance of students. A good number of respondents (11 of the 37 teachers or 29.7%) opined that most students responded positively to the integration of technology in their learning; they stated further that technology integration had improved students' performance, nine or 24.3% agreed also that the students responded positively to the change but revealed that they noted gradual improvement in students' performance; seven or 18.9% observed little improvement; six or 16.2% said the students' performance remained the same; one or 2.7% opined that the students were worse off in performance than before, while three or 8.1% said they had no idea. In all, all the teachers agreed that most of the students were excited about the integration of technology in learning but very few were nostalgic about the development.

TOQ14 - How helpful do you think the infrastructure and resources in Oman higher education are in terms of supporting growth of technology driven education? In your views, what may be the hindrances in the integration or growth of technology in education?

Result: To these questions, only four of the 37 teachers or 10.8% said that the infrastructure and resources in Oman higher education were of great help in terms of supporting growth of technology driven education, five or 13.5% said they were of little help, 18 or 48.6% said they might be of help as events unfold, six or 16.2% said they will

not help, while four or 10.8% had no idea. Those that agreed that the infrastructure and resources in Oman could be of help, however, reasoned that the greatest hindrance would come from low government investment in procurement and maintenance.

TOQ15 - What goal do you aim to achieve through integration of technology in your teaching? How does the integration of technology impact the learning of students in and outside class? Are there any constraints to the learning of students due to use of technology?

Result: Responses to these questions indicated that 28 of the 37 teachers or 75.7% of respondents said the goal was to improve learning with the integration of technology, two or 5.4% suggested greater student integration, one or 2.7% said it was for a better teaching method; two or 5.4% said it was to improve flexibility in learning; another one or 2.7% said it was to improve information generation and dissemination amongst students and teachers, while three or 8.1% who were not involved had no idea.

TOQ16 - Are you excited about the introduction of mobile devices in teaching? Why or why not?

Result: These questions were answered with 21 of the 37 teachers or 56.6% saying yes, they were excited because it gave them some sort of fulfilment and opportunity to broaden their knowledge, five or 13.8% said they were indifferent, eight or 21.6% said they were not excited because it disorganised their way of life and placed unplanned financial burden on their resources, while 8.1% had no idea because they were not involved.

TOQ17 - Would you prepare your teaching materials differently when/if using mobile devices? If so, how?

Result: These questions were answered with 26 of the 37 teachers or 70.3% saying yes because the modus operandi with the two systems of teaching were largely

dissimilar, six or 16.2% had no idea, while five or 13.5% of respondents said no because they reasoned that they could easily adapt their manual teaching methods to being technology-based.

TOQ18 - How do you think your experience as a teacher might be changed by the introduction of mobile devices?

Result: The respondents were of the opinion that the introduction of mobile devices might change their experience for the better (said 16 of the 37 teachers or 43.2%), for good (said 10 teachers or 27%), and not much (said two teachers or 5.4%). Five teachers or 13.5% said the introduction would leave them with no change at all, while four teachers or 10.9% had no idea.

TOQ19 - Can you suggest ways of using mobile devices effectively in class?

Result: The ways suggested by the teachers for using mobile devices effectively in class included web searching (suggested by five teachers or 13.5%), for discipline (suggested by one or 2.7%), group chat and group learning (suggested by 12 teachers or 32.4%), gaming (by 2 teachers or 5.4%), administering quizzes (by five teachers or 13.5%), and home learning assignments (by two teachers or 5.4%). The remaining ten teachers or 27.1% had no idea of what to suggest.

TOQ20 - Would you prefer to use mobile devices in your class to teach English language/mathematics? Why/why not? Please explain.

Result: These questions elicited mixed respondents from the teachers who unfortunately declined to give reasons for their responses. Fourteen of the 37 or 37.8% of the teachers said they would, if given the template. Seven teachers or 18.9% said they might likely want to do so if given the tools. Six or 16.2% said they would not, while 10 or 27% said they had no idea of what to do. This meant that more teachers might likely

want to use mobile devices to teach English language and mathematical courses when the need for them arise.

TOQ21 - How far do you think web-based learning will progress in the coming years and what support can you as a teacher and the government extend to enhance use of technology in higher education?

Result: This question asked more about the likelihood of teachers supporting the extensive introduction of web-based learning and use of technology in Omani higher education in the near future. A good number (15 of the 37 teachers or 40.5%) of respondents said they would support it to a large extent, 14 teachers or 37.8% said they would support to some extent, one or 2.7% said to a less extent, another one or 2.7% was not sure, while six or 16.2% said they did not know how to support it. Invariably, the majority of the teachers favoured the large-scale introduction of the use of technology in higher education in Oman.

To summarise the findings, it is obvious that the introduction of the use of technology in higher education in Oman is an innovation which has multifarious connotations amongst the teachers who are charged with the primary responsibility of driving the implementation of the change. While many were still grappling with the hassles associated with implementing the decision to introduce the use of technology and adapt the use of social media in pedagogy, many more saw it as a pleasant challenge which must be surmounted at all costs to infuse new life into the struggle against the threats posed by the advent of technology and social media in global education philosophy. This position agrees with the views of Qi and Meng (2022) and Williams (2022) on the possibilities offered by the introduction of the use of technology and social media during and after the Covid-19 pandemic (Qi & Meng, 2022; Williams, 2022).

4.3.2 Evaluation and analysis of structured questions

The key findings are described in this sub-section and are set out in more detail in Tables 4.1 to 4.20 and Figures 4.1 to 4.4 (related to the text throughout); these show the results of the repeated measures ANOVA tests on the quantified responses from the students and teachers surveyed over the two-year interval. The findings are presented under (a) students' perceptions (in sub-section 4.3.2-1), and (b) teachers' perceptions (in sub-section 4.3.2-2).

4.3.2-1 Students' perceptions

4.3.2-1(a) Descriptive analysis of students' perceptions

The students' perceptions were gathered from 51 twin-period responses which were structured in Likert-scale like formats. The questions focused on the use of Internet in and outside the university campuses, the modes of online tutorials employed, the types of applications or devices available to students, and the various technological platforms available to students and teachers in the students' higher institution. The students' responses were quantified in line with the Likert scale used for each question and analysed and presented in Table 4.11.

On access to the Internet outside the university, only 85 of the 178 students or 48% of respondents admitted that they had access to internet outside their school in 2021 as against 80 or 45% in 2019. This shows an increase of 3% in outreach to students outside the normal university environment between 2019 and 2021. However, this is still an overall low rate of students' proximity to the Internet outside the university environment to engender a widespread use of online or distance learning in the country. Concerning the use of online resources outside the university, the proximity and strength of the Internet outside the school should be understood. The responses to the survey

question RSQ2 showed that the use of online resources outside the university environment was as high as 54.6% amongst the students.

The students' responses to survey question RSQ3 revealed that as many as 51.6% of students in 2021 owned a laptop or notebook computer compared to 48.8% in 2019. However, responses to question RSQ4 showed that students' ownership of handheld computer devices such as PDAs, Palm Pilots, etc., was not as high as that of laptops. Table 4.11 shows that only 68 of the 178 or 38.4% of students owned handheld computer devices in 2021 as against 65 or 36.4% in 2019. Mobile telephone ownership among the students was much higher than their ownership of laptop computers, as the students responded that 58.6% of them owned mobile telephones in 2021 compared to 54.4% in 2019. Nevertheless, students' ownership and use of iPods or MP3 players seemed to be dwindling as the survey revealed that only 26.8% owned or used them in 2021 as against 27.8% in 2019.

The students' responses to survey question RSQ7 (Table 4.11) revealed that there was an increase in the use of instant message software such as MSN messenger or WhatsApp because 58% of students in 2021 used them as against 55.4% in 2019. Use of blogs seemed not to be particularly popular as only 38% of students admitted to its use in 2021 as against 35.6% in 2019. The same went for sending and receiving podcasts as only 36.8% of students were familiar with this medium of information broadcast in 2021 compared to 32.2% in 2019.

There was a common ground agreement by the students on the issue that their teachers needed to be trained by experts in the use of mobile devices in the classroom. An overwhelming 87% of the students agreed in 2021 and 2019 that their teachers should be trained by experts on the use of mobile devices in the classrooms. As a follow-up, 58.2% of the students, however, opined that their teachers found the mobile device

training difficult, as against 66.2% who said their teachers found the mobile device training more difficult in 2019. This suggests more willingness on the part of the teachers to adapt to changes in 2021 than in 2019. To follow on this, 82.4% of the students agreed that it was possible to show the teachers how to explore the advantages that mobile devices offered for teaching students in 2021 than it was in 2019 at 78.4%.

On the changes coming to the classroom, 146 of the 178 or 82.2% of student respondents agreed that the 'extended classroom interaction' to other places with the help of 'communication networks' is an important advantage of mobile devices for teaching. This was contrasted with 136 or 76.4% of students' agreement on the same question in 2019. Again, 146 students or 82.4% responded in 2021 that streamlined and ubiquitous access to information was possible if teachers adopted mobile devices for teaching their students. This was less strongly reported in 2019 as only 141 or 79% of students thought so. Allied to the students' responses on information access, 142 or 79.8% of students opined that they would be able to learn confidently from the conveniences of their homes or offices if the usage of mobile devices was encouraged. This perception was at the level of 75.6% opined in 2019.

From the analyses of the remaining students' responses to the survey, further findings were noted as follows:

- Teaching through mobile devices connoted working for global development and instilling further development (76%).
- Mobile devices extended the time available for teacher-student communication (77.4%), and honed thinking and memorising abilities of students by presenting ideas and concepts in video, audio, and image forms (78%).
- Teachers should be more open to the use of mobile devices so as to reap the full benefit of mobile technology in the educational setting (82.2%).

- Mobile devices (a) facilitated better contact with parents or guardians of students, thus making it easier to convey information about a student's progress (81.8%), and (b) encouraged students to learn in a positive manner (71.6%).
- Mobile devices facilitated greater student participation, thus enhancing student learning (77.8%), increasing student attention to the task of learning (68%), and helping students to decide space and time for learning (66.2%).
- Distractions from other people increased by 2.6% in an off-classroom learning environment (from 56.6% in 2019 to 59.2% in 2021).
- The presence of a wireless network and virtual environment helped students to access information in less time (76.6%) and enabled students to stay connected with module information (69.8%).
- There was increased sharing of education resources' files, videos, and documents through Facebook groups (from 42.4% in 2019 to 44.2% in 2021), and due to availability of a wireless network and a VLE, students were increasingly finding it easier to learn anywhere (increased from 31.4% in 2019 to 33.8% in 2021).
- Groups on social networking tools helped students to learn outside the classroom (72.6%), gain immediate access to information (61,8%), simplify the process of queries through sharing posts (67.2%), and due to availability of ubiquity technologies, students could spend more time on learning (62%).
- Wireless networking tools encouraged students to learn in a proactive manner (66.4%), while 65.6% of students agreed that mobile learning devices allowed them to become engaged in their studies 24/7, that is, all the time.
- An increased number of students in 2021 gained easy access to their assessment through mobile devices (from 39.8% in 2019 to 42.2% in 2021), while many more

could easily gain access to digital content in 2021 (67.6%) as against 65.4% in 2019.

Students used mobile technology more frequently to learn in less time (70.8%), communicated useful information through messaging, email, and mobile telephone calls (69%), increased their chance of taking part in game quizzes, e-book reading, and webinars (from 44.4% in 2019 to 47.6% in 2021). However, 60.2% did not consider mobile learning as an online learning activity that enhanced effectiveness and productivity.

One hundred and twenty-two of the 178 students, making up to 68.6% of respondents, believed that computer supported collaborative learning allowed them to learn through social interactions and allowed them to save data in the form of emails, audios, and documents which 126 or 70.8% of them believed they could access or retrieve with ease.

The use of online technologies increased the chance of students accessing information in an appropriate way (this improved from 75 of the 178 students or 42.2% in 2019 to 80 or 45.2% in 2021), and enabled students to improve social knowledge sharing and building (118 or 66.2%), while 121 or 68.2% of respondents believed that wireless technology allowed them to focus on universal learning; and 115 or 64.4% opined that they could easily review notes, lectures and other reading material shared by an instructor through accessing a VLE.

The universities provided the students with broadband access so that they could easily learn inside and outside the classroom – this view was provided by 108 or 60.6% of students, while 100 or 56.4% of respondents agreed that their universities used wireless application protocol and wireless fidelity to enable their students to stay connected with internet facility.

4.3.2-1(b) Description of statistical methods used

The question-by-question analysis is shown in more detail in Appendix A which presents Tables A.1 to A.51 that reveal in each case a difference between the students' perceptions on the use of technology in 2019 and their perceptions in 2021, with an overwhelming majority agreeing that their perceptions in 2021 were in excess of their perceptions in 2019. The initial multivariate tests produced by SPSS version 28 on students' perceptions in Table 4.1 with the *F* statistics analysis moderated with Pillai's trace (V), Wilk's lambda (Λ). Hoteling's trace (T), and Roy's large root test (Θ) estimates all returned significant differences between students' perceptions in 2019 and students' perceptions in 2021. Pillai's trace, Wilk's lambda, Hoteling's trace, and Roy's largest root tests are additional tests carried out on multivariate and repeated measures ANOVA tests to show whether there was a significant departure from the assumption of homogeneity of data analysed (Field, 2005); Pillai's trace particularly is a positive valued statistic ranging from 0 to 1 and it shows how the effects of homogeneity or otherwise contributed to the model produced by the analysis (Glen, 2006). The four tests were used to further validate the predictive effect of the model generated by the analysis.

The repeated measures ANOVA tests results indicated that for 2019, the *F* ratio with all the variants of moderations return a *p* value less than .05 inferring that the differences between the responses to the questions asked in 2019 and 2021 are real and significant; with Pillai's trace (V = .957, $F(50,128) = 57.102$, $p < .001$), Wilk's lambda (Λ = .043, $F(50,128) = 57.102$, $p < .001$), Hoteling's trace (T = 22.306, $F(50,128) = 57.102$, $p < .001$), and Roy's largest root (Θ = 22.306, $F(50,128) = 57.102$, $p < .001$).

From the angle of the differences between the responses of individual student respondents' perceptions between 2019 and 2021, the results also returned a *p* value less than .05 indicating that the individual students' perceptions changed significantly

between 2019 and 2021, with Pillai's trace (V = .189, F(1,177) = 41.333, p < .001), Wilk's lambda (Λ = .811, F(1,177) = 41.333, p < .001), Hoteling's trace (T = .234, F(1,177) = 41.333, p < .001), and Roy's largest root (Θ = .234, F(1,177) = 41.333, p < .001).

Table 4.1: Multivariate tests – students' perceptions (overall)[a]

Effect		Value	F	Hypothesis df	Error df	Sig.
2019	Pillai's Trace	.957	57.102[b]	50.000	128.000	<.001
	Wilks' Lambda	.043	57.102[b]	50.000	128.000	<.001
	Hotelling's Trace	22.306	57.102[b]	50.000	128.000	<.001
	Roy's Largest Root	22.306	57.102[b]	50.000	128.000	<.001
2021	Pillai's Trace	.189	41.337[b]	1.000	177.000	<.001
	Wilks' Lambda	.811	41.337[b]	1.000	177.000	<.001
	Hotelling's Trace	.234	41.337[b]	1.000	177.000	<.001
	Roy's Largest Root	.234	41.337[b]	1.000	177.000	<.001
2019 * 2021	Pillai's Trace	.476	2.330[b]	50.000	128.000	<.001
	Wilks' Lambda	.524	2.330[b]	50.000	128.000	<.001
	Hotelling's Trace	.910	2.330[b]	50.000	128.000	<.001
	Roy's Largest Root	.910	2.330[b]	50.000	128.000	<.001

One important test to validate the repeated measures ANOVA test is the Mauchly's test of sphericity. Mauchly's test of sphericity is a test to show whether the data distribution used for the repeated measures ANOVA test violated the assumption of sphericity. Sphericity refers to the condition where the variances of the differences between all combinations of related groups are equal (Zach, 2021).

The sphericity test performed on the data distribution used for this analysis revealed that the sample distribution for the students' perceptions violated the assumption

of sphericity (Table 4.2). However, in line with the norm, the Greenhouse-Geiser and the Huynh-Feldt test values were used to correct the effects of the violation by adjusting the degrees of freedom used to estimate the *F* statistical values in Tables 4.2 and 4.3 (Hinton, Brownlow, & McMurray, 2004). Expectedly, the *F* values estimated using the two in Table 4.2 all returned either $p = .000$ or $p < .001$, thereby indicating that the measures analysed were significantly different in both periods of observation.

Table 4.2: Mauchly's Test of Sphericity – students' perceptions

Measure: Students' Perceptions

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon Greenhouse-Geisser	Huynh-Feldt	Lower-bound
2019	.000	3436.039	1274	<.001	.436	.499	.020
2021	1.000	.000	0	.	1.000	1.000	1.000
2019 * 2021	.000	3153.416	1274	<.001	.545	.647	.020

4.3.2-1(c) Quantitative analysis of students' perceptions

Table 4.3 holds the overall results of the repeated measures ANOVA test for students' perceptions. The results revealed that the students' perceptions on the effect of technology on pedagogy and learning in Oman's higher education in 2021 was significantly different from the students' perceptions in 2019 ($F(1,177) = 10632.944$, $p = .001$). The results of the multivariate tests (Table 4.9 and Table 4.10) corroborate the repeated measures ANOVA results in Table 4.3.

Table 4.3: Tests of within-subjects effects – students' perceptions

Measure: Students' Perceptions

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
2019	Sphericity Assumed	6959.575	50	139.192	86.013	.000
	Greenhouse-Geisser	6959.575	21.787	319.444	86.013	.000
	Huynh-Feldt	6959.575	24.972	278.695	86.013	.000
	Lower-bound	6959.575	1.000	6959.575	86.013	<.001
Error(2019)	Sphericity Assumed	14321.621	8850	1.618		
	Greenhouse-Geisser	14321.621	3856.212	3.714		
	Huynh-Feldt	14321.621	4420.052	3.240		
	Lower-bound	14321.621	177.000	80.913		
Source		Type III Sum of Squares	Df	Mean Square	F	Sig.
2021	Sphericity Assumed	44.713	1	44.713	41.337	<.001

	Greenhouse-Geisser	44.713	1.000	44.713	41.337	<.001
	Huynh-Feldt	44.713	1.000	44.713	41.337	<.001
	Lower-bound	44.713	1.000	44.713	41.337	<.001
Error(2021)	Sphericity Assumed	191.454	177	1.082		
	Greenhouse-Geisser	191.454	177.000	1.082		
	Huynh-Feldt	191.454	177.000	1.082		
	Lower-bound	191.454	177.000	1.082		
2019 * 2021	Sphericity Assumed	75.919	50	1.518	3.922	<.001
	Greenhouse-Geisser	75.919	27.235	2.788	3.922	<.001
		Type III Sum of Squares	df	Mean Square	F	Sig.
	Huynh-Feldt	75.919	32.357	2.346	3.922	<.001
	Lower-bound	75.919	1.000	75.919	3.922	.049
Error(2019*2021)	Sphericity Assumed	3426.414	8850	.387		

Table 4.4: Tests of between-subjects effects – students' perceptions

Measure: Students' Perceptions

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	1808.805	1	1808.805	10632.944	<.001
Error	30.110	177	.170		

The grand mean (Table 4.5) of estimated means of students' perceptions (Table 4.6) revealed that 63.76% of respondents (M = 3.188), with a lower bound and upper bound of 62.54% (M = 3.127) and 64.98% (M = 3.249) respectively on a five level Likert scale at 95% confidence interval, held a strong view that the introduction of technology into the classroom of Omani higher educational institutions was desirable and enhanced the performance of students in 2021 compared to 2019.

Table 4.5: Grand mean of estimated marginal means – students' perceptions

Measure: Students' Perceptions

		95% Confidence Interval	
Mean	Std. Error	Lower Bound	Upper Bound
3.188	.031	3.127	3.249

The estimated marginal means of students' perceptions in 2019 showed how the questions posed met the expectations of the student-respondents (Table 4.6) and suggested the likely direction of their future preferences for accepting changes in educational pedagogy. Table 4.7 clearly indicates that the students' perceptions on the

introduction of technology into the classroom teaching were more positive in 2021 compared to 2019. Table 4.5 showed that the overall mean for 2021 was 3.237 (64.74%) compared to 3.138 (62.76%) in 2019.

Table 4.6: Estimates of marginal means - students' perceptions (2019)

Measure: Students' Perceptions

			95% Confidence Interval	
2019	Mean	Std. Error	Lower Bound	Upper Bound
1	2.326	.061	2.205	2.447
2	2.632	.043	2.547	2.717
3	2.508	.055	2.400	2.617
4	1.871	.066	1.740	2.001
5	2.826	.031	2.765	2.887
6	1.368	.052	1.264	1.471
7	2.834	.033	2.770	2.899
2019	Mean	Std. Error	95% Confidence Interval Lower Bound	 Upper Bound
8	1.843	.067	1.711	1.974
9	1.725	.061	1.604	1.845
10	4.357	.056	4.247	4.467
11	3.110	.076	2.960	3.260
12	4.022	.061	3.903	4.142
13	3.963	.073	3.820	4.107
14	4.037	.065	3.907	4.166

15	3.885	.079	3.730	4.040
16	3.736	.077	3.583	3.889
17	3.801	.084	3.635	3.966
18	3.860	.072	3.717	4.002
19	4.076	.071	3.936	4.216
20	4.067	.070	3.930	4.205
21	3.806	.082	3.644	3.968
22	3.326	.084	3.161	3.491
23	3.194	.087	3.023	3.365
24	2.896	.082	2.735	3.057
25	3.730	.085	3.564	3.897
26	3.402	.082	3.240	3.563
27	2.834	.078	2.681	2.988
28	3.508	.075	3.360	3.657
29	3.374	.092	3.192	3.555
2019	Mean	Std. Error	95% Confidence Lower Bound	Interval Upper Bound
30	3.194	.081	3.033	3.354
31	3.480	.079	3.324	3.636
32	3.267	.079	3.112	3.422
33	3.166	.078	3.011	3.320
34	2.952	.076	2.801	3.103
35	3.323	.074	3.177	3.469
36	3.438	.079	3.283	3.593

37	2.955	.080	2.797	3.113
38	2.955	.084	2.789	3.121
39	2.778	.080	2.620	2.936
40	3.416	.082	3.254	3.577
41	2.702	.073	2.557	2.847
42	2.997	.083	2.834	3.161
43	3.351	.073	3.207	3.495
44	3.323	.076	3.173	3.473
45	3.447	.078	3.293	3.600
46	3.070	.077	2.919	3.221
47	3.306	.073	3.162	3.450
48	2.817	.074	2.671	2.963
49	3.275	.077	3.122	3.428
50	3.301	.071	3.160	3.441
51	3.146	.074	3.001	3.292

Table 4.7: Estimates of marginal means – students' perceptions (2 periods)

Measure: Students' Perceptions

			95% Confidence Interval	
	Mean	Std. Error	Lower Bound	Upper Bound
1 – 2019	3.138	.031	3.076	3.200
2 – 2021	3.237	.032	3.174	3.301

The pairwise comparison presented in Table 4.8 indicated that the students' perceptions for the two periods (2021 and 2019) were significantly different at a 5% critical level. The difference between 2019 and 2021 returned negative while the reverse was the case between 2021 and 2019.

Table 4.8: Pairwise comparisons – students' perceptions

Measure: Students' Perceptions

					95% Confidence Interval for Difference[b]	
(I) 2019	(J) 2021	Mean Difference (I-J)	Std. Error	Sig.[b]	Lower Bound	Upper Bound
1-2019	2-2021	-.099*	.015	<.001	-.130	-.069
2-2021	1-2019	.099*	.015	<.001	.069	.130

Comparison based on estimated marginal means

The combined test of repeated measures ANOVA for the 51 students' perception questions showed an overall significance on a multivariate basis with the *F* ratio returning a *p* value less than the critical value of .05 (Table 4.9) even as moderated with Pillai's trace (V = .957, $F(50,128) = 57.102$, $p < .001$), Wilk's lambda (Λ = .043, $F(50,128) = 57.102$, $p < .001$), Hoteling's trace ($T = 22.306$, $F(50,128) = 57.102$, $p < .001$), and Roy's largest root ($\Theta = 22.306$, $F(50,128) = 57.102$, $p < .001$).

Table 4.9: Multivariate tests – students' perceptions (2019)

	Value	F	Hypothesis df	Error df	Sig.
Pillai's trace	.957	57.102[a]	50.000	128.000	<.001
Wilks' lambda	.043	57.102[a]	50.000	128.000	<.001
Hotelling's trace	22.306	57.102[a]	50.000	128.000	<.001
Roy's largest root	22.306	57.102[a]	50.000	128.000	<.001

Note: Each F tests the multivariate effect of 'TwoYearsAgo'. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

Similarly, the 178 student-by-student responses' tests also returned an overall significance on a multivariate basis with the *F* ratio giving a *p* value less than .05 (see Table 4.10) for 2019 and 2021; even when moderated with Pillai's trace (V = .189, $F(1,177) = 41.337$, $p < .001$), Wilk's lambda (Λ = .811, $F(1,177) = 41.337$, $p < .001$), Hoteling's trace (T = .234, $F(1,177) = 41.337$, $p < .001$), and Roy's largest root (Θ = .234, $F(1,177) = 41.337$, $p < .001$).

Table 4.10: Multivariate tests – students' perceptions (2021)

	Value	F	Hypothesis df	Error df	Sig.
Pillai's trace	.189	41.337[a]	1.000	177.000	<.001
Wilks' lambda	.811	41.337[a]	1.000	177.000	<.001
Hotelling's trace	.234	41.337[a]	1.000	177.000	<.001
Roy's largest root	.234	41.337[a]	1.000	177.000	<.001

Figures 4.1 and 4.2 give pictorial overviews of the significance of the difference in the two periods of measurements of students' perceptions.

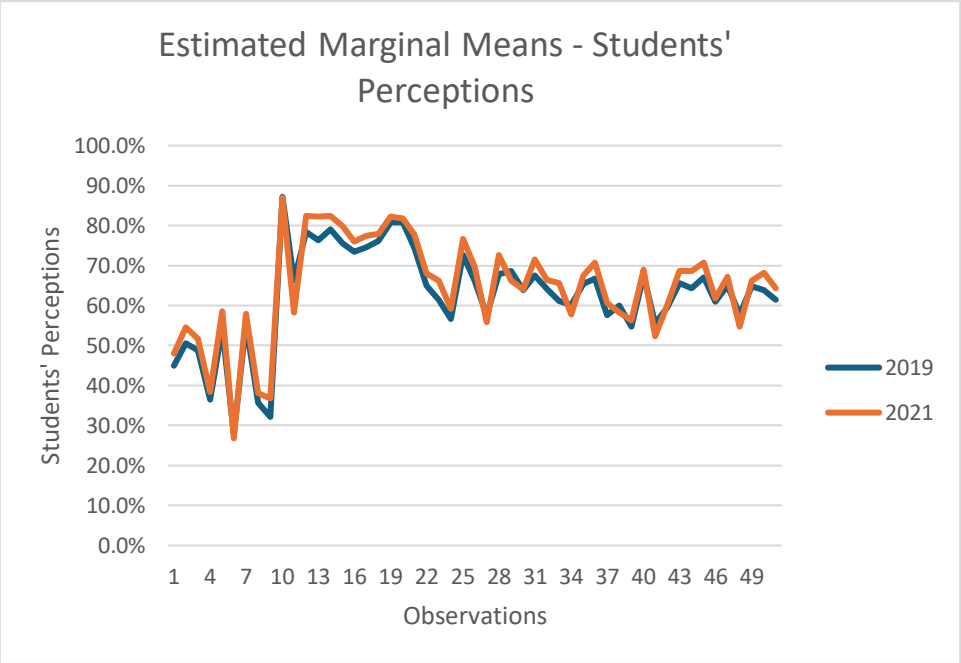

Figure 4.1: Estimated marginal means of students' perceptions

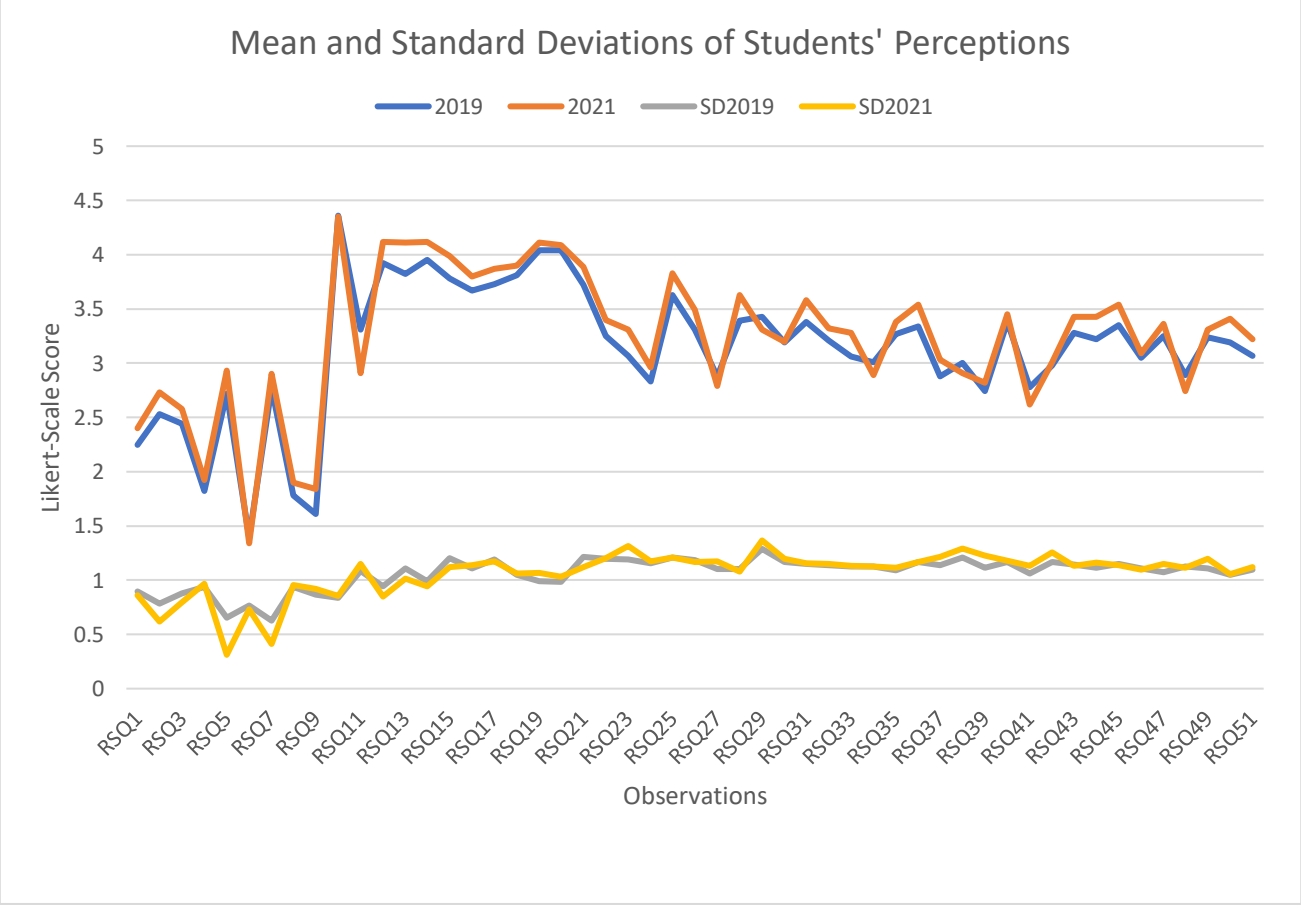

Figure 4.2: Comparative students' perceptions

Table 4.11: Descriptive statistics – students' perceptions

2019	Mean	Std. Deviation	%	N	2021	Mean	Std. Deviation	%	N
SRQ1A	2.25	.895	45	178	SRQ1N	2.40	.859	48	178
SRQ2A	2.53	.782	50.6	178	SRQ2N	2.73	.616	54.6	178
SRQ3A	2.44	.876	48.8	178	SRQ3N	2.58	.793	51.6	178
SRQ4A	1.82	.940	36.4	178	SRQ4N	1.92	.965	38.4	178
SRQ5A	2.72	.655	54.4	178	SRQ5N	2.93	.312	58.6	178
SRQ6A	1.39	.768	27.8	178	SRQ6N	1.34	.729	26.8	178
SRQ7A	2.77	.627	55.4	178	SRQ7N	2.90	.413	58	178
2019	Mean	Std. Deviation	%	N	2021	Mean	Std. Deviation	%	N
SRQ8A	1.78	.940	35.6	178	SRQ8N	1.90	.955	38	178
SRQ9A	1.61	.864	32.2	178	SRQ9N	1.84	.921	36.8	178
SRQ10A	4.36	.834	87.2	178	SRQ10N	4.35	.853	87	178
SRQ11A	3.31	1.084	66.2	178	SRQ11N	2.91	1.151	58.2	178
SRQ12A	3.92	.942	78.4	178	SRQ12N	4.12	.848	82.4	178
SRQ13A	3.82	1.110	76.4	178	SRQ13N	4.11	1.011	82.2	178
SRQ14A	3.95	.993	79	178	SRQ14N	4.12	.943	82.4	178
SRQ15A	3.78	1.204	75.6	178	SRQ15N	3.99	1.120	79.8	178
SRQ16A	3.67	1.108	73.4	178	SRQ16N	3.80	1.135	76	178
SRQ17A	3.73	1.191	74.6	178	SRQ17N	3.87	1.174	77.4	178
SRQ18A	3.81	1.049	76.2	178	SRQ18N	3.90	1.061	78	178

SRQ19A	4.04	.990	80.8	178	SRQ19N	4.11	1.066	82.2	178
SRQ20A	4.04	.985	80.8	178	SRQ20N	4.09	1.032	81.8	178
SRQ21A	3.72	1.212	74.4	178	SRQ21N	3.89	1.122	77.8	178
SRQ22A	3.25	1.196	65	178	SRQ22N	3.40	1.200	68	178
SRQ23A	3.07	1.193	61.4	178	SRQ23N	3.31	1.316	66.2	178
SRQ24A	2.83	1.157	56.6	178	SRQ24N	2.96	1.176	59.2	178
SRQ25A	3.63	1.206	72.6	178	SRQ25N	3.83	1.206	76.6	178
SRQ26A	3.31	1.184	66.2	178	SRQ26N	3.49	1.166	69.8	178
SRQ27A	2.88	1.111	57.6	178	SRQ27N	2.79	1.174	55.8	178
SRQ28A	3.39	1.105	67.8	178	SRQ28N	3.63	1.078	72.6	178
SRQ29A	3.43	1.288	68.6	178	SRQ29N	3.31	1.366	66.2	178
2019	Mean	Std. Deviation	%	N	2021	Mean	Std. Deviation	%	N
SRQ30A	3.19	1.167	63.8	178	SRQ30N	3.20	1.195	64	178
SRQ31A	3.38	1.150	67.6	178	SRQ31N	3.58	1.158	71.6	178
SRQ32A	3.21	1.140	64.2	178	SRQ32N	3.32	1.152	66.4	178
SRQ33A	3.06	1.124	61.2	178	SRQ33N	3.28	1.134	65.6	178
SRQ34A	3.01	1.125	60.2	178	SRQ34N	2.89	1.127	57.8	178
SRQ35A	3.27	1.092	65.4	178	SRQ35N	3.38	1.114	67.6	178
SRQ36A	3.34	1.169	66.8	178	SRQ36N	3.54	1.165	70.8	178
SRQ37A	2.88	1.136	57.6	178	SRQ37N	3.03	1.214	60.6	178
SRQ38A	3.00	1.207	60	178	SRQ38N	2.91	1.290	58.2	178
SRQ39A	2.74	1.116	54.8	178	SRQ39N	2.82	1.226	56.4	178
SRQ40A	3.38	1.169	67.6	178	SRQ40N	3.45	1.179	69	178

SRQ41A	2.78	1.064	55.6	178	SRQ41N	2.62	1.129	52.4	178
SRQ42A	2.98	1.167	59.6	178	SRQ42N	3.01	1.258	60.2	178
SRQ43A	3.28	1.144	65.6	178	SRQ43N	3.43	1.134	68.6	178
SRQ44A	3.22	1.116	64.4	178	SRQ44N	3.43	1.163	68.6	178
SRQ45A	3.35	1.147	67	178	SRQ45N	3.54	1.140	70.8	178
SRQ46A	3.05	1.106	61	178	SRQ46N	3.09	1.096	61.8	178
SRQ47A	3.25	1.073	65	178	SRQ47N	3.36	1.152	67.2	178
SRQ48A	2.89	1.127	57.8	178	SRQ48N	2.74	1.115	54.8	178
SRQ49A	3.24	1.111	64.8	178	SRQ49N	3.31	1.198	66.2	178
SRQ50A	3.19	1.051	63.8	178	SRQ50N	3.41	1.055	68.2	178
SRQ51A	3.07	1.097	61.4	178	SRQ51N	3.22	1.122	64.4	178

4.3.2-2 Teachers' perceptions

4.3.2-2(a) Qualitative analysis of teachers' perceptions

The teachers' perceptions were gathered using twelve twin-period responses which were structured in Likert-scale like formats. The questions focused on the use of Internet in and outside the university campuses, the modes of online tutorials employed, the types of gadgets or devices available to both teachers and students, and the various technological platforms available to students and teachers in Omani higher institutions. The results of the analysis are presented in Table 4.20.

The first four questions focused on the affordability, availability, and training of teachers on the use of mobile devices for teaching. On a threshold of 5, most of the teachers surveyed (27 of the 37 or 73%, $M = 3.65$) held the view that they could afford to acquire the mobile devices necessary for online and technology based teaching; on the one hand, 30 or 80% ($M = 4.0$) of the teachers believed that mobile devices were easy to

access tools for teaching, and on the other hand, 28 or 77.8% (M = 3.89) of the teachers surveyed were willing to undergo the training necessary to use mobile devices for teaching, while 29 or 79% (M = 3.95) of teachers were more interested in learning the techniques mobile devices made available for teaching. In all cases, there was an awareness and acceptance of mobile devices as an aid to teaching.

Other findings from the teachers' perceptions include:

- Teachers found the skills acquired by using mobile devices convenient for teaching (30 of the 37 teachers or 80%, M = 4.0), and they believed that teaching through mobile devices connoted working for global development which instilled the desire for further development (28 teachers or 76.8%, M = 3.84).
- Most teachers (28 of the 37 teachers or 76.8%, M = 3.84) believed that the use of mobile devices for teaching would extend the time available for teacher-student communication unlike the face-to-face classroom experience; in addition, 27 teachers or 75.6% (M = 3.78) of the teachers agreed that mobile devices honed the thinking and memorising abilities of students by presenting material contents in video, audio, and image forms.
- Thirty-one of the 37 teachers or 84.4% of respondents agreed that they needed to be more open to mobile device use so that future generations continued to benefit from mobile technology in the educational setting; 30 of the teachers or 80% of the respondents also agreed that mobile devices facilitated better contact with parents or guardians of students, thus making it easier to convey information about student progress.
- Most of the teachers (27 of the 37 or 73.6%, M = 3.68) believed that mobile devices facilitated greater student participation thereby enhancing student learning; in addition, 26 or 71.4% (M = 3.57) of the teachers also agreed that

mobile devices increased student attention, which was a prerequisite for concentrated learning and grounded understanding.

4.3.2-2(b) Quantitative analysis of teachers' perceptions

A total of 37 teachers participated in this exercise. The initial multivariate tests produced by SPSS version 28 on teachers' perceptions are shown in Table 4.12 with the *F* statistics analysis using Pillai's trace (V), Wilk's lambda (Λ). Hoteling's trace (T), and Roy's large root test (Θ) estimates to return non-significant differences in teachers' perceptions in 2019 but returning significant differences for teachers' perceptions in 2021. The results showed that for 2019: Pillai's trace (V = .407, $F(11, 26) = 1.622$, $p < .151$), Wilk's lambda (Λ = .593, $F(11, 26) = 1.622$, $p < .151$), Hoteling's trace (T = .686, $F(11, 26) = 1.622$, $p < .151$), and Roy's largest root (Θ = .686, $F(11, 26) = 1.622$, $p < .151$).

Table 4.12: Multivariate tests – teachers' perceptions[a]

Effect		Value	F	Hypothesis df	Error df	Sig.
2019	Pillai's Trace	.407	1.622[b]	11.000	26.000	.151
	Wilks' Lambda	.593	1.622[b]	11.000	26.000	.151
	Hotelling's Trace	.686	1.622[b]	11.000	26.000	.151
	Roy's Largest Root	.686	1.622[b]	11.000	26.000	.151
2021	Pillai's Trace	.405	24.511[b]	1.000	36.000	<.001
	Wilks' Lambda	.595	24.511[b]	1.000	36.000	<.001
	Hotelling's Trace	.681	24.511[b]	1.000	36.000	<.001
	Roy's Largest Root	.681	24.511[b]	1.000	36.000	<.001
2019 * 2021	Pillai's Trace	.508	2.442[b]	11.000	26.000	.030

	Wilks' Lambda	.492	2.442[b]	11.000	26.000	.030
	Hotelling's Trace	1.033	2.442[b]	11.000	26.000	.030
	Roy's Largest Root	1.033	2.442[b]	11.000	26.000	.030

However, when the individual teacher-by-teacher perceptions comparisons were carried out for the 2019 and 2021 periods, the results returned an *F* ratio with a *p* value less than .05, with Pillai's trace (V = .405, $F(1, 36) = 24.511$, $p < .001$), Wilk's lambda (Λ = .595, $F(1, 36) = 24.511$, $p < .001$), Hoteling's trace (T = .681, $F(1, 36) = 24.511$, $p < .001$), and Roy's largest root (Θ = .681, $F(1, 36) = 24.511$, $p < .001$). However, a look at the third level of test combining the two periods revealed that all the four tests returned p = .030, which made the combined differences significant at a .05 critical value.

As with the students' perceptions, Mauchly's test of sphericity (see Table 4.13) was conducted on the data distribution for the teachers' perceptions survey. The result of the test also showed violation of the sphericity assumption by the sample distribution; but the effects of the violation have been adjusted for the degrees of freedom used to estimate the *F* statistical values in Tables 4.14 and 4.15. As is the norm, the Greenhouse Geiser and Huynh-Feldt estimates were used for the adjustment. Expectedly, the *F* values estimated using the two in Table 4.13 all returned *p* values less than the critical value of .05 (except for the lower bound), thereby indicating that the measures analysed were significantly different in both periods of observation (2019 and 2021).

Table 4.13: Mauchly's Test of Sphericity – teachers' perceptions

Measure: Teachers' Perceptions

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse-Geisser	Huynh-Feldt	Lower-bound

2019	.012	142.917	65	<.001	.544	.664	.091
2021	1.000	.000	0	.	1.000	1.000	1.000
2019 * 2021	.009	150.777	65	<.001	.557	.684	.091

Table 4.15 shows the overall results of the repeated measures ANOVA test for teachers' perceptions. The results revealed that the teachers' perceptions on the effect of technology on pedagogy and learning in Oman's higher education 2021 was significantly different and higher than it was in 2019 ($F(1, 36) = 1796.546$, p ¸.001). The results of the multivariate tests (Table 4.17 and Table 4.19) corroborate the repeated measures ANOVA results in Table 4.15.

Table 4.14: Tests of within-subjects effects – teachers' perceptions

Measure: Teachers' Perceptions

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
2019	Sphericity Assumed	18.922	11	1.720	2.686	.002
	Greenhouse-Geisser	18.922	5.980	3.164	2.686	.016
	Huynh-Feldt	18.922	7.304	2.591	2.686	.009
	Lower-bound	18.922	1.000	18.922	2.686	.110
Error (2019)	Sphericity Assumed	253.619	396	.640		

2021	Sphericity Assumed	59.055	1	59.055	24.511	<.001
	Greenhouse-Geisser	59.055	1.000	59.055	24.511	<.001
	Huynh-Feldt	59.055	1.000	59.055	24.511	<.001
	Lower-bound	59.055	1.000	59.055	24.511	<.001
Error(2021)	Sphericity Assumed	86.736	36	2.409		

For the teachers' perceptions (multivariate tests shown in Table 4.18) in 2019, Pillai's trace (V = .407, F(11, 26) = 1.622, p < .151), Wilk's lambda (Λ = .593, F(11, 26) = 1.622, p < .151), Hoteling's trace (T = .686, F(11, 26) = 1.622, p < .151), and Roy's largest root (Θ = .686, F(11, 26) = 1.622, p < .151), all show non-significant differences at the critical value of .05. This non-significance has, however, been adjusted for the joint significance test reported in preceding paragraphs.

Table 4.15: Tests of between-subjects effects – teachers' perceptions

Measure: Teachers' Perceptions

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	480.781	1	480.781	1796.546	<.001
Error	9.634	36	.268		

For the teachers' perceptions (multivariate tests shown in Table 4.19) in 2021, Pillai's trace (V = .405, F(1, 36) = 24.511, p < .001), Wilk's lambda (Λ = .595, F(1, 36)

= 24.511, $p < .001$), Hoteling's trace ($T = .681$, $F(1, 36) = 24.511$, $p < .001$), and Roy's largest root ($\Theta = .681$, $F(1, 36) = 24.511$, $p < .001$), all show significance at the critical value of .05.

The estimated marginal means for the responses from the twelve questions posed to the teachers (shown in Table 4.16) indicated that the teachers' perceptions on the introduction of technology into classroom teachings in Oman was, on the average, higher than 60%. However, Table 4.18 indicates that such perceptions were more positive in 2021, 77.26% ($M = 3.863$), than they were in 2019, 66.94% ($M = 3.347$), on a threshold of 5.

Table 4.16: Estimated marginal means – teachers' perceptions (2019)

Measure: Teachers' Perceptions

			95% Confidence Interval	
2019	Mean	Std. Error	Lower Bound	Upper Bound
1	3.541	.138	3.262	3.819
2	3.568	.127	3.309	3.826
3	3.635	.114	3.404	3.866
4	3.581	.102	3.375	3.787
5	3.608	.112	3.382	3.834
6	3.568	.115	3.335	3.801
7	3.581	.115	3.347	3.815
8	3.608	.123	3.359	3.857

9	3.932	.117	3.696	4.169
10	3.838	.127	3.580	4.096
11	3.405	.125	3.151	3.660
12	3.392	.155	3.077	3.707

Table 4.17: Multivariate tests on estimated marginal means – teachers' perceptions (2019)

	Value	F	Hypothesis df	Error df	Sig.
Pillai's trace	.407	1.622[a]	11.000	26.000	.151
Wilks' lambda	.593	1.622[a]	11.000	26.000	.151
Hotelling's trace	.686	1.622[a]	11.000	26.000	.151
Roy's largest root	.686	1.622[a]	11.000	26.000	.151

Table 4.18: Estimated marginal means – teachers' perceptions (2021)

Measure: Teachers' Perceptions

			95% Confidence Interval	
	Mean	Std. Error	Lower Bound	Upper Bound
1-2019	3.347	.106	3.132	3.561
2-2021	3.863	.093	3.673	4.052

Minimum = 1, Maximum = 5

Table 4.19: Multivariate tests on estimated marginal means – teachers' perceptions (2021)

	Value	F	Hypothesis df	Error df	Sig.
Pillai's trace	.405	24.511[a]	1.000	36.000	<.001
Wilks' lambda	.595	24.511[a]	1.000	36.000	<.001
Hotelling's trace	.681	24.511[a]	1.000	36.000	<.001
Roy's largest root	.681	24.511[a]	1.000	36.000	<.001

Figures 4.3 and 4.4 give pictorial overviews of the significance of the difference across the two periods of measurements of teachers' perceptions.

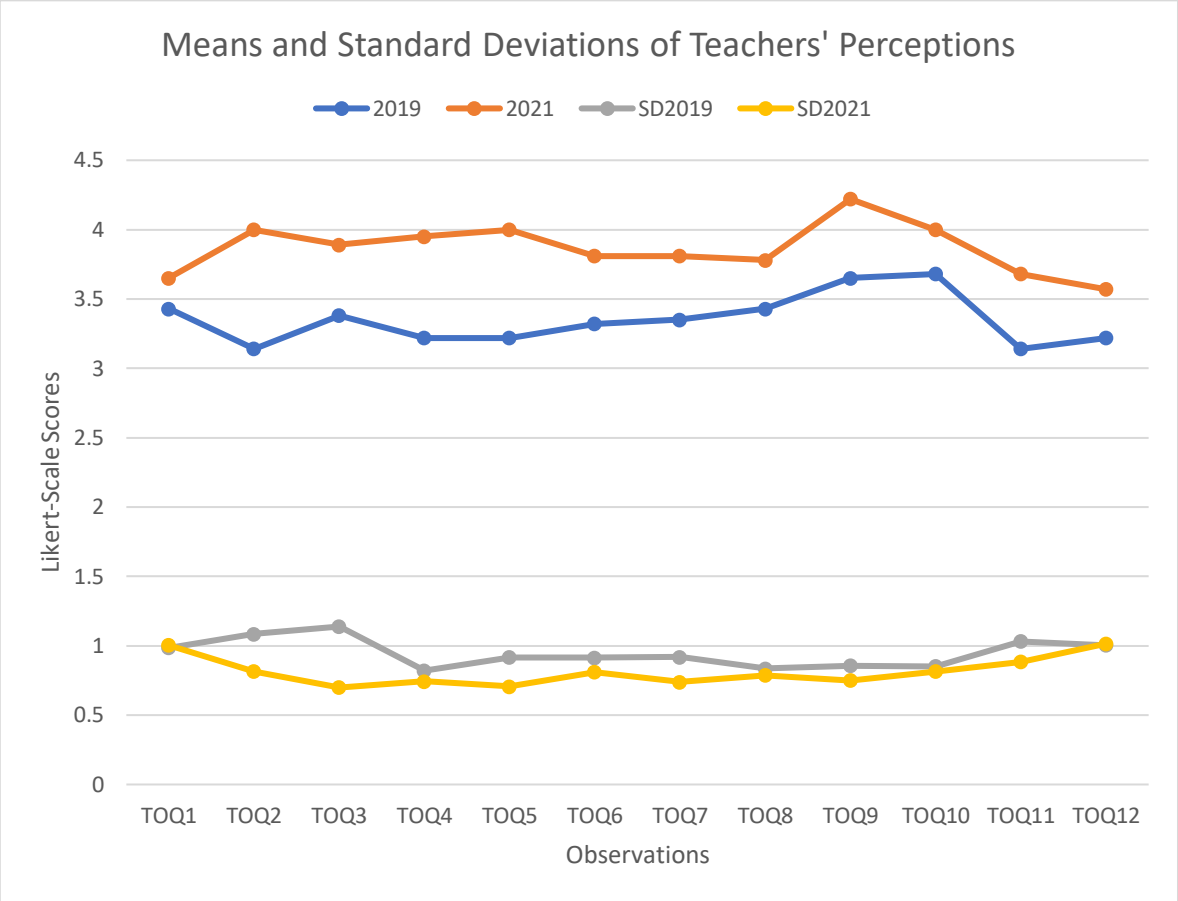

Figure 4.3: Comparative teachers' perceptions

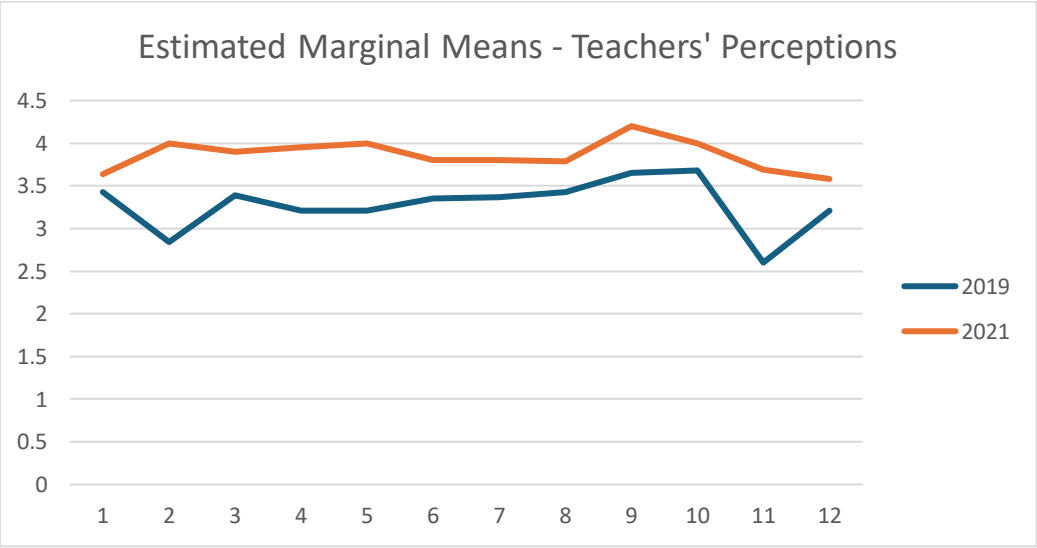

Figure 4.4: Estimated marginal means of teachers' perceptions.

Table 4.20: Descriptive statistics – teachers' perceptions

	TSQ2019 Mean	Std. Deviation	%	N	TSQ2019 Mean	Std. Deviation	%	N
TSQ1	3.43	.987	**68.6**	37	3.65	1.006	**73**	37
TSQ2	3.14	1.084	**62.8**	37	4.00	.816	**80**	37
TSQ3	3.38	1.139	**67.6**	37	3.89	.699	**77.8**	37
TSQ4	3.22	.821	**64.4**	37	3.95	.743	**79**	37
TSQ5	3.22	.917	**64.4**	37	4.00	.707	**80**	37
TSQ6	3.32	.915	**66.4**	37	3.81	.811	**76.2**	37
TSQ7	3.35	.919	**67**	37	3.81	.739	**76.2**	37
TSQ8	3.43	.835	**68.6**	37	3.78	.787	**75.6**	37
TSQ9	3.65	.857	**73**	37	4.22	.750	**84.4**	37
TSQ10	3.68	.852	**73.6**	37	4.00	.816	**80**	37
TSQ11	3.14	1.032	**62.8**	37	3.68	.884	**73.6**	37
TSQ12	3.22	1.004	**64.4**	37	3.57	1.015	**71.4**	37

4.4 Overall summary of findings

In summary, as depicted in Table 4.21, the study findings yield evidence pertaining to the potential or actual impact of the integration of technology into the academic jurisdiction of higher education in Oman. Through a mixed methods research methodology, the findings provide an insight into the opinions and experiences of students and teachers regarding how they feel about the transition from a teacher-centred educational approach to a more student-centred, technology-driven teaching and learning model. Based on the summary of findings depicted in Table 4.21, key findings

include the evidence that points to a trend of greater usage of technology within the realm of academia by multiple stakeholders, students and teachers.

Table 4.21: Summary of Findings

Finding	Description
Increased use of technology	Greater use of technology within academia by participant Omani students and teachers.
Student enthusiasm	Participant Omani students have embraced various technologies both inside and outside the classroom.
Positive teacher attitudes	The majority of participant teachers in Oman view technology positively, noting benefits such as reduced workload and enhanced efficiency.
Concerns about infrastructure	Participant Omani teachers are concerned about the lack of infrastructure, training, and government support for technology-driven education.
Improved teaching and learning	Integration of technology into Omani education is perceived to improve teaching methods and student learning experiences.
Enhanced collaboration and communication	Participants indicate that technology positively impacts collaboration, communication, and access to multimedia resources within the Omani educational landscape.
Need for relevant teaching methods	Participant teachers in Oman stress the importance of adapting teaching methods and materials to leverage technology effectively.
Call for support from the Omani government	Stronger Omani government support and improved institutional infrastructure are needed to facilitate technology-driven education in Oman.
Challenges to address	Challenges related to infrastructure, training, and equitable access must be addressed for effective integration of technology into Omani education.
Potential for transformative impact	Findings serve as a resource for policymakers, educators, and stakeholders to leverage the transformative potential of technology in Omani higher education.

While teachers tended to adapt to a pedagogical approach to utilise more and multiple technological platforms, systems and devices, in large part, students embraced many different types of technology not only in the classroom but also within the external environment, demonstrating an implicit enthusiasm. The majority of teachers were relatively positive about the uses of technology both at the time of the study and for the future, citing real benefits such as a reduced workload and enhanced work efficiency. Yet, they voiced concerns about the lack of infrastructure, teacher training, and general lack of government support in driving forward technology-driven education.

The findings suggest that teaching methods and student learning experiences can be improved via the integration of technology, and according to the results in the previous chapter, the application of this technology was largely perceived by participants to positively impact these two stakeholders via improved collaboration, communication, and access to multimedia resources. Teachers tended to remain concerned about the importance of adapting to relevant teaching methods and materials to better leverage systems, devices and online platforms. Most teachers believed that there was a need for stronger government support and also an improved institutional infrastructure in Omani education to facilitate and optimise technology-driven education.

It is apparent from the findings that there is an intricate interplay between shaping the educational landscape of Oman with better applications of pedagogy, technology, and institutional support. Technology on its own cannot transform the existing Omani education landscape as this country requires concerted efforts to address challenges related to infrastructure, training, and equitable access. As Omani education

stakeholders adapt and adopt the rapidly changing realm of technology-based education in this digital period of time, these findings may be a valuable resource for policymakers, educators, and stakeholders, all of whom seek to access and leverage the transformative potential of technology in higher education.

CHAPTER FIVE

DISCUSSION

5.1 The need for this study

5.1.1 Overview

The theoretical framework for this study was focused on theories of educational change. The Covid-19 pandemic brought with it some person-to-person restrictions which hitherto were uncommon, especially in educational institutions, and particularly in classroom environments. This research study covered the period from the year 2019 to 2021, while the research post-field activities for literature reviews and data analysis extended up to the end of the year 2022. Coincidentally, the Covid-19 pandemic broke out towards the end of the year 2019, but its full effects and restrictions became highly notable from the month of March 2020. Prior to the pandemic, the global leap in the development and advanced use of information and communications technology (ICT) products had begun to change the way things could be done around the world and the education sector actively benefited from this. One of the changes prominently engendered was exploring increasingly a transition from teacher-centred, transmission models of education to more student-centred, constructivist models.

5.1.2 Gaps filled

A student-centred constructivist model implies thinking of learning in a much broader sense, including the possibility of students learning without a teacher, in different locations, and at different times than had been considered previously. Also, in this transition context, there is a need to position pedagogical change as a product of teacher/student learning and development, rather than seeing technology as mere tools for performing tasks or as change formulated elsewhere to be implemented in classrooms (Hoban, 2002). This position was well encapsulated in the work of Kennedy (2005) which

explains how teachers learning and reflecting as part of a continual process of their development is a theoretical stance away from "the constricting nature of the standards, accountability and performance management agenda, could arguably be categorised as a poststructuralist approach" (Kennedy, 2005, p.5).

One major aspect and probable impediment to change is the initial scepticisms about the change or even total refusal to accept the change. This study was conducted to evaluate how teachers related to technological and pedagogical changes in terms of whether the changes were primarily seen as transmissive, imposed from elsewhere, or an enabling and transformative opportunity to reflect on and to advance practice. As such, methodological design from a post-structuralist theoretical framework was informed by concepts of "relativity, plurality, fragmentation, and anti-foundationalism" (Given, 2008, p.23).

Previous studies on students' perceptions focused more on individual acceptance of the effects of technology innovation in education in the Middle East, but such studies fall short of the expectations of detail identified through this research. For instance, El Alfy, Gomez, and Ivanov (2017) using an exploratory quantitative study focused on technological readiness of a UAE university, Ajzen and Fishbein (1980) contextualised their study with the theory of reasoned action, while Trowler (1998) considered the professional identity of an individual but did not take the attitudinal aspect of the particular ways in which academics respond to change into account. The major difference between the mentioned studies and this research is anchored in the fact that this study treated the students involved as a community rather than as individuals. This is because students, being mostly adolescents, tend to learn and develop better as groups than as individuals. It is noticeable amongst students that an individual member of a peer group can succumb more to the influence of peer pressure than taking individual initiatives.

Two studies have shown that peer groups and peer pressure have significant impacts on adolescent development. Steinberg and Monahan (2007) suggested that peer pressure can be a significant predictor of adolescent risk-taking behaviour, while Viner et al. (2012) found that peer groups can have a strong impact on a student's mental health and well-being. In addition, the study used perceptions across two periods of time to investigate the periodic growth in the acceptance level of technology introduction into the Omani higher educational institutions. Though the study focused on Omani higher educational institutions, inspirations were drawn from the studies conducted in the UAE.

5.1.3 Methodology adopted

This study adopted a mixed methods research investigation which included using both qualitative and quantitative means of data gathering and analysis. The basic tools employed in the execution of the research project included the use of self-administered questionnaire and oral interviews where respondents were indisposed to written answers. The questionnaire design included both structured and open-ended segments for teachers and students alike. The questions asked were of a twin nature – one to gauge the perception of the respondents two years earlier and the other to ascertain what their perceptions were at the moment of the survey. There were fifty-one such twin questions (structured) for the student respondents, whilst the teachers were asked to complete twelve structured and twenty open-ended questions. The structured questions were organised using the 5-point Likert scaling measurement. The number of participants in the survey included 178 students and 37 teachers.

In this study, efforts were made to gather the perceptions of both students and teachers about their views of the introduction of technology into Omani schools' classrooms in 2019 and 2021 on a qualitative basis; however, a quantitative approach was used to evaluate how their perceptions had changed over the two periods.

5.2 Analysis and results

The data collected from the survey and the findings given in Chapter 4 were in accordance with the need to resolve the following research questions:

- What forms of technology do the students use for learning inside/outside the classroom and for social interaction in Omani and how has this usage changed since technology first started to be used as a teaching tool in Oman in 2001, and particularly between 2019 and 2021?
- Do teachers use different forms of technology for different purposes? How does this impact on teaching and learning in HE? To what extent have teachers embraced the changes in technology since it was first introduced in Oman in 2001, and particularly between 2019 and 2021?
- What are the perceptions of Omani HE students and teachers about using technology for learning and teaching inside and outside the classroom? How have changes in technology, for example, mobile devices or e-learning, impacted these perceptions?

The second part of the first research question dwelt more on how technology had changed between 2019 and 2021 than the change itself. The second part of research question two dealt with the extent to which teachers embraced the changes in technology between 2019 and 2021, while the last part of the third research question sought to know how changes in technology had impacted the perceptions of both teachers and students. The objective of gaining the perceptions of students and teachers at two different time intervals justified the need for a statistical test to determine the differences in the two periods' perceptions. Following this analogy, and specifically to perform the tests of differences in perceptions, the study formulated the following hypotheses:

H_0 – 1: There is no significant difference in students' perceptions of changes in technology affecting learning and pedagogy in Omani higher educational institutions between 2019 and 2021.

H_1 – 1: There is a significant difference in students' perceptions of changes in technology affecting learning and pedagogy in Omani higher educational institutions between 2019 and 2021.

H_0 – 2: There is no significant difference in teachers' perceptions and acceptance of changes in technology affecting learning and pedagogy in Omani higher educational institutions between 2019 and 2021.

H_1 – 2: There is a significant difference in teachers' perceptions and acceptance of changes in technology affecting learning and pedagogy in Omani higher educational institutions between 2019 and 2021.

5.2.1 Qualitative analysis results (teachers' open-ended questions)

The analysis of the open-ended questions produced interesting results not far from the study's *a priori* expectations (see Appendix A). These more specific and detailed results based on interview feedback are presented and discussed in the sub-sections following.

5.2.1(a) Juxtaposing technology induced teaching in higher education with preferred individual styles of teaching

On the general acceptance of the idea of integrating technology into classroom teaching, as many as 31 (83.8% of 37 respondents) expressed their happiness and acceptance of integrating technology into classroom teaching, while six (16.2%) were not sure of their position on that aspect. Nevertheless, no one rejected the idea outright.

5.2.1(b) – Effects of integrating technology such as mobile devices or wireless networking in the Oman education sector on teaching. Does it help you in delivering knowledge in the same or any better way or does it offer more constraints than benefits?

The diverse opinions expressed by respondents to this question exposed the divergent level of the teachers' exposure to the working and underlying essence of technology in classroom teaching. While some followed the development with keen interest and appreciated the extra knowledge gained, others simply tagged along with reluctance induced out of the compulsion to move along with the unfolding reality of contemporary global events in education and were rewarded with less proficiency than the enthusiastic ones.

5.2.1(c) - Respondents views on the flexibility of web learning and the use of blended learning for facilitating flexible education for students. Can web learning deliver the same benefits as in class teaching?

The responses to this question still showed that there were still some measures of scepticism surrounding web learning, which is a component of the technology-based education. While some teachers still struggled to keep their existing classroom teaching method due to insufficient knowledge and scanty devices and support, others were encouraged by the satisfaction they derived from their hands-on participation and the expectation of promised government and institutional support. But in all, they expressed a general hope that improvements in technology-based teaching could lead to better flexibility in education using blended learning which may enable web learning to deliver the same or better benefits in pedagogy with class teaching.

5.2.1(d) - Use of mobile devices in teaching enhances student learning

The implication of the diverse responses to this question was that the majority of the teachers subscribed to the fact that the use of mobile devices in teaching enhanced

students' learning and offered the flexibility of distance, place, timing and comfort to both teachers and students. But to those who were less exposed to technology-based teaching, the idea of enhancing students' learning seemed impossible. However, many agreed that use of mobile devices in teaching greatly minimised the risk of person-to-person contact especially during a critical period such as the Covid-19 pandemic.

5.2.1(e) – Mobile devices in teaching methods address mobility, access, and immediacy

Mobility is an important factor in education which affects teachers' productivity and students' performances, especially where teachers and students attend classes from off-campus abodes. Ease of access on the other hand can be seen as an alternative to mobility when it offers the advantage of instant access to classroom resources. The question was posed to know whether mobile devices could impact the mobility and timely access to learning resources when they are integrated into classroom teaching. A good number of respondents (26/37 - 70.3%) suggested that mobile devices in teaching methods minimised the issue of mobility and granted immediate access to classroom resources, two (5.4%) were not sure, six (16.2%) did not believe it could, while three (8.1%) said they did not know. However, none of the respondents were able to give reasons for their responses.

5.2.1(f) – How well does educational context and the ubiquity of mobile devices work in providing an enhanced learning experience?

It was apparent that the responses given tallied with the level of exposure of each teacher respondent to the use of mobile devices in teaching. Nevertheless, it was generally agreed that the ubiquity of mobile devices blended well in providing an enhanced learning experience irrespective of the divergent opinions of the teachers.

5.2.1(g) – Mobile devices allow viewing of videos, images, and graphics better in an HE setting

The tie in opinion notwithstanding, the position of all was that future developments might increase the level of acceptance of mobile devices as a useful platform for viewing videos, images and graphics meant for pedagogical purposes. But for now, the use of mobile devices to view images and graphics is considered with mixed feelings, low acceptance and scepticism.

5.2.1(h) - Communication is best and uninterrupted when mobile devices are used for teaching purposes

The importance of clear and unambiguous communication in an educational environment can never be over-emphasised. This is primarily due to the fact that students' understanding is squarely anchored in how clearly the students recognise and understand the teacher's communication. This is probably the reason the question posed on communication created some problem of indecision for the respondents. This implies that there were palpable feelings of doubt amongst the majority of respondents for the fear of the unknown; just as there was no guarantee that communication would be uninterrupted when mobile devices were used extensively for teaching purposes. A good number of teachers expressed some doubts on the general integrity of data stored on mobile devices and on those transmitted online through wireless networks for the fear of possible loss of confidentiality and security of vital information which are better controlled under the regime of the physical classroom.

5.2.1(i) – Favouring the different sources of technology available for use in and outside classroom teaching

The implementation of a virtual classroom cannot be accomplished without the necessary tools like Internet-enabled mobile devices and even intelligent physical

classroom equipment. This question aimed to identify the different sources of technology available for the use of the teachers in Omani higher institutions in and outside classroom teaching. Most of those surveyed mentioned that the Zoom and Google Classroom applications were most preferred because of their tendency to reach participants that were remotely dispersed, while others preferred web learning using the Moodle or Kahoot platforms because of their added flexible learning features such as personalised study time and online study groups.

5.2.1(j) – Possibility of web learning replacing classroom education in coming years

The increasing popularity of web learning globally, especially during the Covid-19 pandemic, generated massive interest amongst educational administrators in various countries. This necessitated the need to investigate the possibility of it replacing physical classroom education. The question on the possibility of web learning replacing classroom education in coming years was posed to ascertain if web learning was considered beneficial to teachers and students and whether it had the potential to replace classroom teaching in the post-pandemic future. All respondents, however, agreed that web learning was beneficial to students especially during the pandemic and might likely increase in usefulness as more user-friendly advances in mobile device technology and online learning applications became ubiquitous and more people were connected online.

5.2.1(k) - How the teachers developed the expertise to use technology in teaching

The success of any innovation or change depends largely on how the intended beneficiaries of such change adapt to its tenets and modus operandi. The issue of training and support by governments is a vital ingredient in the adoption, promotion, and sustenance of the change object which translates to the use of technology in teaching in this case. Generally, proficiency training in the use and adaptation of ICT devices is a costly venture in many climes, which an individual may not be able to shoulder without

institutional or government support. This question asked the teachers to show how they developed and funded their technology use expertise. From the responses of the teachers, it can be observed that only personal efforts and institutional supports were available to the teachers in Oman for the purpose of developing the expertise required to advance the use of technology in classroom teaching. The government of Omani was yet to offer any support save for the policy approval during the period covered by this research.

5.2.1(l) – Students' responses to the integration of technology in learning as it affects their academic performance

The major benefits expected from the development of technology-based classroom learning were listed in Sharma et al. (2017) to include flexibility, suitability, enjoyment, usefulness, feasibility, and efficiency. In that publication, Sharma et al. (2017) suggested that students expect to interact in a largely self-determined and organic manner, by being able to access their learning resource information in different and more convenient ways just as with social media. This question sought to know the effects of technology integration on students' receptibility and assimilation of course teaching, evaluation of teaching process, and their academic performance in examinations conducted.

5.2.1(m) – The adequacy of Omani higher education infrastructure and resources in supporting growth of technology driven education

Oman, like other countries in the Middle East, geared up to the demands of global crisis and the developments in ICT, by providing the enabling regulations, physical infrastructure, and environment upon which technology in education might grow. However, in many Middle Eastern countries, Oman inclusive, there are other hurdles to surmount before a smooth festering ground for inclusion of technology in pedagogy can be reached. These mostly behavioural hurdles include culture, students' preferences, and

regional expectations (Al-Senaidi, Lin, & Poirot, 2009; Salloum, Al-Emran, Shaalan, & Tarhini, 2019; Sarrab, Al-Shihi, Al-Khanjari, & Bourdoucen, 2018; Tawafak, Romli, & Alsinani, 2019). Based on the aforementioned, this question was posed to find out how supportive the government of Oman has been perceived to be in the provision of the basic and necessary infrastructure that forms the backbone of integrating technology in education in the country.

Most of the pessimistic responses anchored on the human factor of culture, language, and preferences, because the focus of technology in the Middle East is more on how e-learning can be assimilated into existing traditional pedagogy rather than drive globally-induced pedagogical change (Iskander, 2014). Lack of immediate availability of the local language version of the technology also constituted a cog in early acceptance of technology because latest technologies are rarely available in Arabic (Taha, 2007). In summary, the lack of enthusiasm in giving exact or requisite responses to this important question could also be attributed to the reticent nature of the average Arab student and teacher towards adopting constructivist approaches to teaching and learning (Al-Senaidi, Lin, & Poirot, 2009; Porcaro, 2011).

5.2.1(n) – The expected goal for the integration of technology in teaching, the impact on learning of students and constraints

The integration of technology in classroom teaching is a global project borne out of the need to make pedagogy and learning in education flexible, affordable, and less stressful. Online learning first appeared in 1982 as a developmental follow-up to the introduction of correspondence courses in the 1800s (Kentnor, 2015; Rowan & Feenberg, 1983). The major aim was to deliver a distance education programme to business executives outside the campus (Rowan & Feenberg, 1983). This aim has since expanded to include the need to accommodate other students who may not have the ability or

finances to attend a normal school. In addition, the need to take advantage of new technologies in education and minimise the risk of contracting infections during pandemics also bolstered the thinking of the protagonists of online education.

The summary of the respondents' answers to this question highly suggests that the aims of the teachers for their involvement in technology-based teaching aligned well with the current global expectations. Other unstructured responses of the teachers also suggested that the integration of technology in learning impacted positively on the majority of the students but were quick to add that lack of financial resources to acquire the needed enabling devices and the paucity of Internet access by way of poor wireless networks outside the campus constituted a major source of constraint for seamless technology-based learning by students.

5.2.1(o) – Excitement and enthusiasm on the introduction of mobile devices in teaching

Every change or innovation comes with mixed feelings. The integration of technology in teaching is no different. The question was posed to gauge the level of personal sentimental satisfaction each teacher derived or was expected to derive from the integration of technology or the introduction of mobile devices in teaching. Particularly, it brought flexibility and made it easier for students and teachers to discuss problems relating to their courses outside the classroom and school environment and it made the setting, administration, marking, and grading of quizzes easy. They also opined that it created time and made communication with class groups simple, quick, and effective. Nonetheless, the overall perception amongst the teachers was that of enthusiasm and hope for a greater, beneficial and more flexible technology-based method of teaching.

5.2.1(p) – Preparation of teaching materials under technology-based teaching

Every system has its own method of engagement. The physical classroom system comes with its own processes and procedures of engagement that are different from online

or technology-based teaching. The question on the topic of teaching material preparation sought to know whether the teachers received the required training on how to prepare and deliver course materials in technology-based teaching. The majority of the teachers said they prepared their teaching materials based on the requirements of the technology they used revealed that the technology-based methods were quite distinct from the normal classroom teaching method. This was not unexpected.

5.2.1(q) - How the introduction of mobile devices in teaching might change a teacher's experience

Every change calls for a shift in paradigm for the handlers of the object of change. The question was intended to evaluate how the teachers had benefited from their experience in handling technology-based teaching. When considered together, the overall opinion of the teachers suggested that the introduction of mobile devices in teaching would probably change the experience of the teachers involved in technology-based teaching for the better.

5.2.1(r) - Suggested ways of using mobile devices effectively in class

Group learning, administering quizzes, and web searching were the major ways suggested by the teachers on how mobile devices could be effectively deployed in the classroom. Other ways suggested for using mobile devices included gaming, home learning assignments, and discipline (whatever that meant) in that order.

5.2.1(s) – Teaching English language and mathematical courses using mobile devices in class

It was evident from the answers provided by the respondents that the teaching of English language and mathematics were not the favourite of teachers who handle online or technology-based classes. This was basically because no standard procedure was available for the teaching of online courses in Oman at the time of this study execution.

This meant that more teachers might likely want to use mobile devices to teach English language and mathematical courses when provided with the template and other resources required to deal with the peculiar nature of each subject.

5.2.1(t) – The extent of progress expected from web-based learning in the coming years and the support expected from teachers and the government to enhance the use of technology in higher education

This question sought to know the likelihood of teachers supporting the extensive introduction of web-based learning and use of technology in Omani higher education in the near future. Invariably, the majority of the teachers favoured the large-scale introduction of the use of technology in higher education in Oman, especially as most of them agreed that the government of Oman had done a lot to provide the basic infrastructure and the enabling environment necessary for unhindered operation of technology-based teaching in the country.

To summarise the teacher qualitative findings, it was obvious that the introduction of the use of technology in higher education in Oman was a worthy innovation which had multifarious connotations amongst the teachers who were charged with the primary responsibility of driving the implementation of the change. While many were still grappling with the hassles associated with implementing the decision to introduce the use of technology and adapt the use of social media in pedagogy, others saw it as a pleasant challenge which must be surmounted at all costs to infuse new life into the struggle against the threats of obsolescence posed by the advent of technology and social media in global education philosophy. This position agrees with the views of Qi and Meng (2022) and Williams (2022) on the possibilities offered by the introduction of the use of technology and the social media during and after the Covid-19 pandemic (Qi & Meng, 2022; Williams, 2022).

5.2.2 Qualitative analysis results (students' structured questions)

The 178 student-participants in this study responded to the fifty-one twin questions which formed the basis for the periodic tests of differences in perceptions. These responses enabled the students to offer more details based on their opinions and experiences. In addition, the responses were also used to evaluate the readiness, preferences, and expectations of the students on the change gradually creeping into global education pedagogy, specifically as it affects higher educational institutions in Oman. The responses to the questions were grouped in line with the category or aspect of technology integration with which the students were actively involved (see Appendix A). These included availability of the Internet and other online resources outside the campus, ownership of laptops and other handheld devices, mobile communication equipment such as telephones, iPods, MP3 players, PDAs, participation in online group work and web learning.

The use of the Internet and other online resources outside the university campus reported by the 178 students jumped from 45% to 48% between 2019 and 2021 (the period of research execution), a small but significant increase of 3% in outreach to students outside the normal university environment between 2019 and 2021. However, 48% was still an overall low rate of students' proximity to the Internet and online resources outside the university environment to support a solid venture into online or distance learning in the country. Nevertheless, the situation was encouraging, with a higher rate in the use of online resources outside the university reported by students at 54.6%.

Ownership of laptops and other computer handheld devices reported by students increased from 48.8% in 2019 to 51.6% in 2021; however, students' ownership of handheld computer devices such as PDAs, Palm Pilots, etc., was not as high as that of laptops (see Table 4.11). Coincidentally, the ownership and use of iPods or MP3 players

seemed to be dwindling as there was a decrease of 1% in usage over the previous two years. This could be explained by the fact that laptops have better capability in terms of storage, speed, clarity, and better graphic display screens and can in fact replicate the services of these other devices in a more efficient and cost-effective way. Table 4.11 also revealed that the use of instant messaging apps such as MSN messenger and WhatsApp increased by as much as 3.4% over the two-year period in line with the increase in the ownership and use of computer laptops. The same trend was noted in the use of blogs and podcasts.

The need for teachers' education was stated as a common consensus by the students regarding the issue of expertise in the use of mobile devices in the classroom. The students overwhelmingly polled to express their desire to have their teachers undergo expert training on the use of mobile devices in the classrooms (at 87%) but were optimistic that their teachers' improvement in the use of mobile devices was on the increase. This invariably suggests more willingness on the part of the teachers to adapt to changes in 2021 than in 2019. As many as 82.6% (147 of the 178) students surveyed were eager and prepared to show the teachers how to explore the advantages that mobile devices offer for teaching students in 2021 than was the case in 2019.

The introduction of technology to the classroom necessitated that there be extended classroom interaction to other places, but this could only happen with the help of communication networks which the students regarded as an important advantage of mobile devices for teaching. Furthermore, a sizeable number (76.4%), 136 of the 178 students surveyed, agreed that streamlined and ubiquitous access to information could be possible if teachers adopted mobile devices for instructing their students. This was not the case in 2019, even as the students expressed better ability to learn with confidence from the conveniences of their homes or offices.

The students' responses to the survey also brought to the fore other interesting findings which are summarised, as follows. Teaching through mobile devices connoted and encouraged working for global development and instilled further development in educational pedagogy given new global realities. It was established that mobile devices extended the time available for teacher-student communication, and to hone thinking and support memorising abilities of students by presenting lectures, images, and conceptual ideas in video, audio, and clearer graphic image forms. Openness of teachers to the use of mobile devices could help to reap the full benefit of mobile technology in the educational setting. This was the opinion of 146 (82%) of the students surveyed. The students' opinions also unravelled the fact that mobile devices facilitated better contact with parents and guardians of students and encouraged students to learn in a positive manner, thus making it easier to convey information about a student's progress in less time.

It was also established that mobile devices facilitated greater student participation, increased students' attention, and enhanced students' learning and helped students to decide space and time more conducive to them for learning. However, the negative side of relying more on off-classroom teaching using mobile devices was the attendant increase in distractions from other people or events which rarely happened in a close classroom environment. But timeliness of information access and the ability of staying connected seemed to overshadow the disadvantage of distractions.

Perhaps the most notable benefit of mobile technology in education was the increased sharing of education resources in the form of files, videos, and documents through Facebook groups and wireless networks which gave students the opportunity to learn anywhere with ease. Mobile technology teaching also simplified the process of query sharing by social media posts due to the ubiquity of mobile technology platforms

such as MSN messengers, Facebook and Twitter, which enabled students to spend more time on learning. This view agrees with the findings of Williams (2022) in the study offering an overview of social media in education. The workability of mobile technology was made possible and flexible for students to learn in a proactive manner due to the availability of wireless networking tools without which information broadcast, transmission and receivership would be impossible.

Students used mobile technology more frequently to learn in less time, communicated useful information through messaging, email, and telephone calls, increased their chance of taking part in game quizzes, e-book reading, and webinars. However, some students did not consider mobile learning as an online learning activity that enhanced effectiveness and productivity. Learning through social interactions and saving of data in emails, audio, and textual files which could be retrieved with ease were made possible using computer collaborative learning supported by online technologies. It was also established that wireless technology allowed students to focus on universal learning, and easily reviewed notes, lectures and other reading material shared by an instructor through a VLE access.

In Omani universities, it was revealed that the school authorities did provide students with broadband access to enhance their ability to learn inside and outside the classroom. This basic gesture went a long way to cement the foundation of technology-based teaching in those universities. This, in the opinion of the students, was expected to be augmented through student purchase and ownership of mobile devices such as Internet-enabled laptop computers, iPods, iPads, and smart mobile telephones, for example. The two major impediments or problems faced by many students was the cost of device acquisition and training, an area where many issues had been raised and escalated to both government and school authorities for possible assistance. Nonetheless,

the respondents agreed that their universities used wireless application protocols and wireless fidelity to enable them to stay connected with Internet facility.

5.2.3 Qualitative analysis results (teachers' structured questions)

As with the students' perceptions survey, the teachers' perceptions were quantitatively and qualitatively analysed and their responses to the survey questions offered more details about the use of technology in teaching than was previously disclosed in Chapter 4. The twelve questionnaire questions were used to dissect and propagate the evaluation of research questions 2 and 3 which were focused among other things on the teachers' attitudes to the use of technology in teaching. They covered aspects such as the availability of the Internet within and outside the university campuses, the modes of online tutorials employed, the types of gadgets or devices available to both teachers and students, and the various technological platforms available to students and teachers in Omani higher institutions. The results of the analysis were presented in Table 4.20.

Affordability, availability, and training of teachers on the use of mobile devices for teaching were the primary concern of the teacher-respondents. While most of the teachers surveyed (27 out of 37) (73%) held the view that they could afford to acquire the mobile devices necessary for online and technology-based teaching on their own, 30 (81%) of them believed that mobile devices provided easy access tools for teaching. Nevertheless, 29 (78.4%) of the 37 teachers surveyed were willing to undergo the training necessary to use mobile devices for teaching if they could be assisted financially, while the same number were more interested in learning the techniques mobile devices made available for teaching. From the purview of the foregoing, there was a great awareness and acceptance of mobile devices as aids to teaching amongst teachers in Omani higher educational institutions. The current debate among the teaching stakeholders in the world

and particularly in the Middle East is no longer on the awareness or the acceptability of technology in education but the efficient combination of teaching software for complementary advantages to ensure high-quality online teaching (Qi & Meng, 2022).

Convenience, time saving, and flexibility in teaching were among the high-end expectations of the teachers surveyed. The most comforting aspect of the survey was that the majority believed that teaching through mobile devices connoted working for global development which instilled the desire for further development. In addition, 29 (78.4%) of the 37 teachers agreed that the use of mobile devices for teaching extended the time available for teacher-student communication, unlike the face-to-face classroom experience. Another 28 (75.7%) of the 37 teachers believed that mobile devices honed the thinking and memorising abilities of students by presenting material contents in video, audio, and image forms. This was reflective of the students' performance in quizzes and other technology-based class assignments and agrees with the findings of Qi and Meng (2022) and Williams (2022).

Constant and effective communication between the teachers and students' parents or guardians was made easier, faster, and less costly by the use of mobile devices which enabled the school authorities to convey information about student progress and gained the desired parental feedback. Students' participation and attention were enhanced significantly using mobile devices in teaching and this, in the opinion of the teachers, facilitated students' concentration and aided deeper understanding of the lessons. This is also in agreement with the findings of Williams (2022) and Qi and Meng (2022).

Recent studies, focused on e-learning and m-learning in Oman, only tangentially addressed learning habits and focused heavily on the early stages of implementing technologies in teaching using previous learning habits, but they rarely encouraged or facilitated new ones. The gap addressed in this study focused on current learning habits,

the new ways of learning that might be facilitated by e-learning or m-learning options and the constraints faced by students as to how they want to learn. The fact that social media and use of mobile devices has become more prevalent in Oman necessitated the need to evaluate their use in learning and particularly on how students and teachers alike perceived their usefulness.

5.2.4 Hypotheses tests and evaluation

This study was based on a two-pronged approach, the qualitative aspect which focused on respondents' attitudes to the various elements forming parts of the overall change in technology-driven global education pedagogy, and the quantitative aspect which enabled a comparative measurement between earlier attitudes to technological change in education pedagogy and the 2021 attitude. The repeated measures analysis of variances (ANOVA) was the major tool used in the latter measurement. To interpret the results of the measurement, the research hypotheses formulated in Sub-section 5.2.1 were deployed.

5.2.4(a) Quantitative results summary and hypothesis test (students' perceptions)

The hypothesis to be tested for students' perceptions on the introduction of technology in teaching in Oman is as follows:

- H_0 – 1: There is no significant difference in students' perceptions of changes in technology affecting learning and pedagogy in Omani higher educational institutions between 2019 and 2021.
- H_1 – 1: There is a significant difference in students' perceptions of changes in technology affecting learning and pedagogy in Omani higher educational institutions between 2019 and 2021.

The accept/reject criterion of the test falls within the threshold of a 5% critical value, meaning that if the *p* value is greater than .05, we do not reject the null hypothesis (H_0),

but if it is to the contrary, then we reject the null hypothesis (H_0) and accept the alternate hypothesis (H_1).

The combined test of repeated measures ANOVA for the 51 students' perception questions showed an overall significance on a multivariate basis with an *F* ratio returning a *p* value less than the critical value of .05 (see Table 4.9) even as moderated with Pillai's trace (V = .957, $F(50,128) = 57.102$, $p < .001$), Wilk's lambda (Λ = .043, $F(50,128) = 57.102$, $p < .001$), Hoteling's trace (T = 22.306, $F(50,128) = 57.102$, $p < .001$), and Roy's largest root (Θ = 22.306, $F(50,128) = 57.102$, $p < .001$).

From the results summarily presented, it was evident that all the versions of the *F* ratio (as moderated with Pillai's trace, Wilk's lambda, Hoteling's trace, and Roy's largest root) returned *p* values less than .001 suggesting the null hypothesis (H_0) be rejected in favour of the alternate hypothesis (H_1), which states that: ***There is a significant difference in students' perceptions of changes in technology affecting learning and pedagogy in Omani higher educational institutions between 2019 and 2021.***

Similarly, the 178 student-by-student responses' tests also returned an overall significance on a multivariate basis with the *F* ratio giving a *p* value less than .05 (see Table 4.10) for 2019 and 2021, even as moderated with Pillai's trace (V = .189, $F(1,177) = 41.337$, $p < .001$), Wilk's lambda (Λ = .811, $F(1,177) = 41.337$, $p < .001$), Hoteling's trace (T = .234, $F(1,177) = 41.337$, $p < .001$), and Roy's largest root (Θ = .234, $F(1,177) = 41.337$, $p < .001$). The hypothesis test for this data segment followed a similar pattern and result to the earlier test.

5.2.4(b) Quantitative results summary and hypothesis test (teachers' perceptions)

The hypothesis to be tested for teachers' perceptions on the introduction of technology in teaching in Oman is as follows:

- H_0 – 2: There is no significant difference in teachers' perceptions and acceptance of changes in technology affecting learning and pedagogy in Omani higher educational institutions between 2019 and 2021.
- H_1 – 2: There is a significant difference in teachers' perceptions and acceptance of changes in technology affecting learning and pedagogy in Omani higher educational institutions between 2019 and 2021.

Table 4.15 shows the overall results of the repeated measures ANOVA test for teachers' perceptions. The results revealed that the teachers' perceptions on the effect of technology on pedagogy and learning in Oman's higher education in 2021 was significantly different and higher than it was in 2019 ($F(1, 36) = 1796.546$, $p < .001$). From the immediately preceding results, it could be seen that the F ratio for the overall perception returned a p value less than .001 suggesting that the null hypothesis (H_0) be rejected in favour of the alternate hypothesis (H_1), which states that: ***There is a significant difference in teachers' perceptions and acceptance of changes in technology affecting learning and pedagogy in Omani higher educational institutions between 2019 and 2021.***

When subjected to the hypothesis test, the teacher-by-teacher perception results (multivariate tests can be seen in Table 4.19) has the following outcome - Pillai's trace ($V = .405$, $F(1, 36) = 24.511$, $p < .001$), Wilk's lambda ($\Lambda = .595$, $F(1, 36) = 24.511$, $p < .001$), Hoteling's trace ($T = .681$, $F(1, 36) = 24.511$, $p < .001$), and Roy's largest root ($\Theta = .681$, $F(1, 36) = 24.511$, $p < .001$). With all showing significance at the critical value of .05, we reject the null hypothesis and conclude as with the overall ANOVA test.

5.2.5 Implications of the findings

Having considered the qualitative and the quantitative analyses of the data generated from this study, it is pertinent to point out the notable implications of this

research study's findings. The main areas of interest are indicated as – a) change trend identification, b) expectations from the change, and c) requirements to embrace and sustain the change.

The execution of the qualitative and quantitative analyses brought to the fore the need to prepare for an upsurge in the demand for technology-based education in the immediate future. From the review of the various literatures on e-learning and m-learning, it became evident that there is a dire need for changes in educational pedagogy as dictated by global trends in technological development. This need is even further exacerbated by the occurrence of some natural force majeure such as the global Covid-19 pandemic which tends to dictate the way humans relate and do business with each other.

The periodic differences between the perceptions of both teachers and students on the introduction of technology in the classroom from the quantitative analyses suggests a growing trend in the use of technology in education with a positive indication of widespread acceptance of technology as the new paradigm in education pedagogy. To buttress this view, the estimated marginal means of students' perceptions (see Table 4.6) further suggested the likely direction of students' future preferences for accepting changes in educational pedagogy. Table 4.7 clearly indicated that the students' perceptions on the introduction of technology into classroom teaching were at a higher level in 2021 compared to 2019. Table 4.7 showed that the overall mean for 2021 is 3.237 (64.74%) compared to 3.138 (62.76%) in 2019.

The estimated marginal means for the responses from the twelve questions posed to the teachers (see Table 4.16) also indicated that the teachers' perceptions on the introduction of technology into classroom teachings in Oman was, on the average, higher than 60%. Notably, Table 4.18 indicated that such perceptions were higher in 2021 at 77.26% (M = 3.863) than they were in 2019 at 66.94% (M = 3.347) on a threshold of 5.

Expectedly, the growing acceptance of technology in education implicitly suggests that many institutions of higher learning would be considering or getting ready to augment previously exclusive classroom courses with technology-based versions and some might even go ahead to mount new exclusive technology-based pedagogical courses. When this becomes the case, the responsibility of providing the needed enabling technological infrastructure, practice regulation, and process control would fall on both the government of the land and the originating institutions. The ability to manage the associated pressure would be the selling point of the new educational direction.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

Research studies in education, social sciences, and humanities are conducted to identify contemporary societal problems with the aim to offer or suggest effective solutions to these problems. There has been significant contribution to knowledge due to the advancement in technology, especially in terms of communication technology in developing economies such as Oman (Al-Shboul & Alsmadi, 2015). This is especially true in the field of higher education as both teachers and students can deliver and absorb knowledge via flexible access to digital resources; such can raise teaching and learning standards. Emerging generations of students are naturally very technology-friendly, so it is posited that Oman/UAE faculty members and administrators leverage this emerging learning trend within the realm of higher education (Al-Shboul & Alsmadi, 2015).

Naturally, every research project is expected to achieve the general objectives for which the study was conducted. New developments in Information and Communications Technology (ICT) coupled with the continued search for a flexible, effective, and more acceptable methods of imparting knowledge especially in a period of global constraints in movements and interactions between persons such as the Covid-19 pandemic, have necessitated the introduction of a virtual classroom or technology-based education.

This study was conceived and engendered by the need to focus pedagogy on a student-centred constructivist model which aims to shift the role of a physical teacher by changing personal contacts between the teacher and the students, thereby further enabling students to become responsible in part for their own learning regardless of the diverse locations in which they may find themselves. This flexible approach enables students to study at different times and at their own convenience. The study was also designed to

support pedagogical change resulting from the integration of technology in learning as a product of teacher/student initiative to stimulate increased acceptability of the concept amongst learners, as posited by Hoban (2002). This position was further articulated to facilitate a gradual departure from a teacher-centred philosophy to a joint teacher/student-centred initiative. This proposition agrees with the work of Kennedy (2005), which posits that teacher-based philosophy in pedagogical development creates a theoretical gulf between students' needs and the eventual deliveries from the teachers.

This research study was conducted to evaluate how teachers related to technological and pedagogical changes in terms of whether the changes were primarily seen as transmissive, imposed from elsewhere, or an enabling and transformative opportunity to reflect on and to advance practice. In a similar manner, the study measured students' perceptions not as individuals but as a group, as explained in section 5.1.2, to understand how the changes in pedagogy had evolved over a 2-year time period, how such changes had been evident from the integration of technology in their learning process, how this process had affected them, and how the perceptions had changed over a two-year period. This is in contrast with the focus of previous studies on students' perceptions in the Middle East which dealt more with individual students' acceptance of the effects of technology innovation in education rather than on groups' acceptance, including groups such as those falling under the Oman Ministry of Health and institutions focused on health sciences.

The study used a two-pronged approach of qualitative analysis with thematic evaluations of respondents' answers using nine themes (see section 3.6.1), and quantitative evaluations of the statistical analysis derived by converting the 63 structured questionnaire questions' responses into 5-point Likert scale sores, to arrive at valuable conclusions. The process of data analysis included the evaluation of two hypotheses

derived from the research questions and subjected to significant tests at a 5% significance level. The statistical tests used the repeated measures analysis of variances (ANOVA), and the attendant post-hoc evaluations tested the difference between the teachers' and students' perceptions across the two periods using Mauchly's test of sphericity to ensure that the assumption of sphericity was met in the data distribution used for the repeated measures ANOVA tests. Subject specific conclusions are highlighted at salient points in the following sub-sections.

These two different sets of qualitative and quantitative conclusions detailed as follows serve to indicate the use and exploitation of technology in higher education in Oman, increasingly commonly perceived as a valid teaching mechanism. However, while there are still reservations primarily within some of the teaching staff concerning how the integration of technology and adaptation of social media can be efficiently implemented, many teachers view the delivery of such technology, while challenging, also as a benefit to the Omani higher education system. Statistical analysis serves to validate that the experiences leveraged by the integration of newer technologies by both teacher and student stakeholders was largely positive. Over the study's two-year time period, it has become apparent that current teacher and student perceptions and attitudes towards the increased utilisation of technology in higher education in Oman has been mostly favourable, albeit some stakeholders possessing some reservations.

6.1.1 Conclusions from the qualitative research

a) Juxtaposing a conventional style of teaching with technology-induced teaching in higher education, the majority of the teachers agreed that the introduction of technology in teaching worked better than a non-technology based conventional teaching method due in part to more flexibility; such newer technology had positively impacted teaching standards in higher education in Oman.

b) Integrating technology such as mobile devices or wireless networking in the Omani education sector improved students' attitudes towards the system of education in the country. Though there were some dissenting voices, the majority nevertheless favoured the development.

c) The flexibility of web learning and the use of blended learning facilitated flexible education for students and could deliver the same benefits as with conventional classroom teaching when supported with the technology platforms, devices, tools, and sufficient resources.

d) The use of mobile devices in teaching enhanced student learning and minimised the risk of person-to-person disease transmission during a critical period such as the Covid-19 pandemic.

e) Mobile devices in teaching minimised the problem of mobility and granted immediate access to learning resources at the convenience of students.

f) It was established that the popularity and common use of mobile devices blended well in providing an enhanced learning experience for students by supporting them with the needed resources for greater and faster ease of communication irrespective of the divergent opinions of the teachers.

g) Opinions were highly in favour of the use of mobile devices to view videos, images, and graphics in an HE setting, as it was established that the use of improved visual screens on mobile devices projected videos, images, and graphics in a crisp and clear manner.

h) Students' understanding was enhanced when communication from the teacher was clear and unambiguous, and this was achieved better in technology-based learning as students were more at ease and naturally familiar with such technologies; this translates to a scenario in which communication is enhanced, is

quicker, and is relatively uninterrupted when mobile devices are used. However, there is need to ensure that confidentiality and integrity of data and information stored or transmitted using mobile devices or through wireless networks are guaranteed.

i) The study established that the Zoom and Google Classroom applications were the most preferred options for technology-based education by both teachers and students because of their tendency to reach participants that were remotely dispersed. Web learning using the Moodle or Kahoot platforms was listed as the next preferred options because of their added flexible learning features such as personalised study time and online study groups.

j) Though it was found that web learning was beneficial to students, especially during the pandemic, and may likely increase in usefulness as more user-friendly advances in mobile devices technology and online learning applications become ubiquitous and more people are connected online, the possibility of web learning replacing classroom education in coming years was, however, considered remote.

k) One of the key ingredients in the successful implementation of technology-based learning is teacher education. Teacher education in Oman during this period was achieved through personal efforts and institutional support through training and device procurement. These gestures enabled the teachers to be fully engaged in technology-based teaching to develop and acquire the expertise needed to advance the use of technology in classroom teaching. The government of Oman on its own provided policy enablement during the period.

l) Students' academic performance was observed to have improved at a statistically significant level during the two-year period under investigation and this was attributed to the integration of technology in learning which brought about greater

students' adaptability and assimilation of course teachings, facilitated better assessment of teaching processes due to quicker and more flexible feedback, and enabled students' academic performance evaluation. These aspects of the study findings agree with the major benefits expected from the development of technology-based classroom learning as listed in Sharma et al. (2017).

m) The study calls to question the adequacy of Omani higher education infrastructure and resources in supporting the growth of technology-driven education. This is because in Oman and Middle East countries there are behavioural hurdles such as culture, students' preferences, and regional expectations which must be surmounted before a meaningful progress can be made in technology-based learning (Al-Senaidi, Lin, & Poirot, 2009; Salloum, Al-Emran, Sarrab, Al-Shihi, Al-Khanjari, & Bourdoucen, 2018; Shaalan, & Tarhini, 2019; Tawafak, Romli, & Alsinani, 2019). Also, the current focus on technology in the Middle East is more on how e-learning can be assimilated into existing traditional pedagogy rather than driving globally-induced pedagogical change (Iskander, 2014). There is a general lack of local language versions of the technology which breeds some level of pessimism in the outright acceptance of technology due to non-availability of the Arabic language content (Taha, 2007). This is an area where government intervention can help.

Generally, the introduction of the use of technology in higher education in Oman was often perceived as a worthy innovation with multifarious beneficial connotations (such as more efficient teacher input and student output) amongst teachers and students. While many teachers, and to a lesser extent students, are still challenged with implementing the integration of technology and adapting the use of social media in pedagogy, others see the development as a beneficial hurdle which must be surmounted

at all costs to keep ahead with the realities occasioned by the advent of technology and social media in global education philosophy. This agrees with the views of Qi and Meng (2022) and Williams (2022) on the possibilities offered by the introduction of the use of technology in education.

This study established that methods of preparing and delivering teaching resources in integrated technology learning situations differed significantly from the normal non-technology learning situations. While materials must be prepared and transmitted in a customised media-compliant mode in a technology-based learning environment, the manual method of preparing course outlines and delivering the same is favoured for physical classroom learning. The study further established that courses like English language and mathematics could be adapted for technology-based learning without too many problems, provided that a standard template pertaining to the activity structure would be made available. The study also found that the use of mobile devices was strongly suggested for quiz administration, group learning, group charting, web-learning, teacher-student interaction, teacher-parent-guardian communication, and dissemination of learning materials.

For the students, teaching through mobile devices connoted and encouraged working for global development and instilled further development in educational pedagogy, given new global realities. It extended the time available for teacher-student interactions and helped to hone thinking and memorising abilities of students by presenting lectures, images, and conceptual ideas in video, audio, and clearer graphic image forms. The use of mobile devices facilitated quicker and more accessible contact with parents and guardians of students and encouraged students to learn in a positive manner, making it less difficult to convey timely information about a student's progress. In addition, the use of mobile devices facilitated greater student participation in class,

increased students' attention, enhanced students' learning, and helped students to decide space and time more conducive to them for learning, if they could minimise distractions from people or events in their immediate environment. Notwithstanding, timeliness of information access and the ability to stay connected were believed to overshadow the disadvantage of distractions.

The study revealed further that the most notable benefit of mobile technology in education was the increased sharing of educational resources such as files, videos, and documents through Facebook groups and wireless networks, which gave students the opportunity to learn anywhere with ease. Mobile technology teaching particularly simplified the process of query sharing through social media posts. The ubiquity of mobile technology platforms such as MSN Messenger, Facebook and Twitter ensured the possibility of this aspect and enabled students to spend more time on learning. Williams (2022), in the study titled 'An overview of social media in education', corroborated this finding. Wireless networking particularly was responsible for the workability of mobile technology which provided flexible methods for students to learn in a proactive manner.

Learning through social interactions and saving of data in emails, audio, and textual files which could be retrieved with ease were made possible using computer collaborative learning supported by online technologies. The study noted further that wireless technology allowed students to focus on universal learning, which is a way of teaching that facilitates the needs of students and removes or avoids unnecessary limitations and restrictions within the learning process, and also enabled them to easily review notes, lectures and other reading material shared by an instructor through a VLE access. The progress recorded so far with integrated technology learning was made possible because Omani universities provided students with broadband access to enhance their ability to learn inside and outside the classroom.

6.1.2 Conclusions from the quantitative research

The quantitative aspect of this study was designed to measure the existence and growth of the benefits of integrating technology in learning through students' and teachers' perceptions. The study measured the growth (or otherwise) in benefits of technology in learning by comparing the earlier perceptions and attitudes of respondents to the integration of technology in teaching (two years previously in 2019) with their current perceptions and attitudes (2021) for both students and teachers. The repeated measures ANOVA results which were subjected to two hypothetical tests returned the result that there are significant differences in students' perceptions of changes in technology affecting learning and pedagogy in Omani higher educational institutions between the two periods.

The results for both hypothetical tests revealed an upward trend and positive differentials in perceptions for both teachers and students, indicating a significant increase in the use, participation, and acceptability of technology-based learning over the period covered by the study. This fact was further evidenced with the increase in the marginal means of the data distribution for students' perceptions from M = 3.138 (62.76%) two years before to M = 3.237 (64.74%) in 2021 and was further corroborated by the increase in the marginal means of the data distribution for teachers' perceptions from M = 3.3347 (66.94%) two years before to M = 3.863 (77.26%) in 2021.

6.1.3 Contribution to knowledge

It is posited that this study has contributed to knowledge in an area where there was a research gap pertaining to the affect the emergence of new technologies would have on the teaching and learning process in the higher education system in Oman. These study findings offer new insight into the favourable attitudinal shift over a two-year period by

both students and teachers towards the inclusion of increasing technology platforms, devices, and tools such as smartphones.

6.2 Recommendations

The recommendations from the findings of this study are presented in the following sub-sections.

6.2.1 Recommendations for improvements in Oman higher education

The findings of this study derived from both the students' and the teachers' responses indicated an urgent need to prepare for an upsurge in the demand for technology-based education in Oman in the immediate future. From the review of the various literatures on e-learning and m-learning, it became clear that there is a genuine desire for changes in educational pedagogy as dictated by natural events and global trends in technological development. Particularly, the global Covid-19 pandemic was an unpleasant surprise which changed and dictated the way humans related to and did business with each other. In view of this reality, this study recommends a total review of global educational methods and direction to take into consideration the need for flexible, distant, and technology-based learning (Hoban, 2002; Kennedy, 2005).

Secondly, each educational institution and curriculum development body should consider developing curricula to accommodate both conventional and non-conventional learning methods, especially as there are indications in the findings that many students now prefer flexible and non-conventional learning methods made possible through web learning and mobile devices to conventional classroom learning. Thirdly, governments and regulatory authorities globally should consider and endeavour to increase the budget for the provision of enabling technological infrastructure, and review the laws enabling integration of technology in learning to take care of the increasing demand for technology-based non-conventional learning.

Furthermore, the growing acceptance of technology in education implicitly suggests that Omani institutions of higher learning should as a matter of urgency consider and be ready to augment previously exclusive classroom courses with technology-based versions and mount new exclusive technology-based pedagogical courses in line with students' demands. In addition, templates relating to activity structures for the teaching of courses considered intricate and technical should be developed to enable students interested in such courses to take advantage of the flexibility offered by distant and technology-based learning.

6.2.2 Recommendations for further research

This research study focused basically on identifying the methods, platforms, and devices used currently and across a previous two-year period as the means of achieving the integration of technology into learning in Omani higher education institutions. It also covered the attitudinal aspects of the students' and teachers' participation in technology-based learning and their reported effects on students' performance within the period of the study. The study noted the use of many devices, products, and platforms which included mobile telecommunications equipment such as smartphones, iPods, iPads, MP3 players and tablets, used by different schools in the process of executing technology-based learning. Other devices used included smartboards, computer laptops, web learning platforms such as Zoom and Google Classroom, social media platforms such as Facebook, WhatsApp, Instagram, and Twitter, and e-learning platforms such as Moodle and Kahoot.

Though this study considered the overall effect of these devices and platforms together on the perceptions of both teachers and students and the resulting students' performances, it did not, however, take the perceptions of respondents on each individual tool or platform into consideration. This non-consideration of the effect of the individual

devices and learning platforms in the measurement of respondents' attitudes and perceptions created a gap which needs to be filled by future research. In like manner, the study further recommends follow-up research on the possible effects of non-integration of local language and culture into the instruction manuals or operating instructions of the devices used in technology-based teaching in Oman and the Middle East. It is posited that further 2-year-period change studies could follow-up, to enable the change picture to be updated at regular intervals.

6.2.3 Limitations of the research study

There have been multiple limitations imposed on this research study due to the researcher's relative lack of experience in undertaking a doctoral study that is worthy of peer reviewed scholarly research. Another limitation pertains to the difficulties faced with choosing and selecting the most appropriate research participants. The researcher acknowledges that the sample size that was investigated could have been expanded, thereby providing a more comprehensive set of perspectives about the research problem and possible solutions. The researcher was also challenged by the limited amount of secondary literature pertaining to the area of investigation within higher education in Oman.

The researcher concedes that at this time the study has been conducted with a lack of long-term and wide research experience, at doctoral level. This limitation could have negatively affected the depth and the scope of this research study. There were also limitation issues concerning the sample size and selection due to limited resources; this could have impacted investigation of this research by reducing the breadth of opinions and perspectives. A bigger and more diverse sample could have offered a greater understanding of the research problem. Another limitation pertains to the possibility of

researcher bias, especially when participants were found to be outgoing, warm, and friendly, which could have influenced the research findings gathered.

This study posits that more time could have been allocated on this doctoral study, as the data were gathered over a period of two years. A longer-term study may have led to more adequately capturing of changes and developments witnessed in technology integration in higher education in emerging economies such as Oman. It appears that pro-technology attitudes and trends towards more technology in higher education may evolve beyond the scope of this research, impacting the generalisability of the findings. It was found that there was a general lack of relatively recent peer-reviewed secondary literature that was relevant to the study's focus on the integration of technology in Omani higher education. It was apparent from the scholarly literature that noted limitations above can hinder how a researcher can acquire knowledge to fully understand the dynamics between students and teachers in Oman.

The limitation concerning a two-year study period, which is a relatively short period of time, impacted the decision-making process about the construction of a sample drawn from different disciplines; in the study, samples were based within the field of health sciences. As these samples were primarily based within this field, this may offer a limitation in terms of generalisability of the findings beyond this field. However, some of the samples were studied in different disciplines within health sciences, and this may be beneficial to the study in terms of potential wider generalisability.

The final limitation concerns the use of a bespoke instrument without conducting prior piloting, which raises concerns about limitations posed concerning some aspects of reliability and validity of the generated data. Without using a pilot study as a tool to understand and validate the instrument's appropriateness and effectiveness, there is a risk of inaccuracy in measurement, bias in terms of response, and the misinterpretation of

samples' responses. This limitation could also limit the accuracy and comprehensiveness of the findings, thereby limiting the robustness and validity of the study's findings and conclusions. Upon reflection, the study findings should be critically considered, while acknowledging methodological limitations that are commonly associated when an instrument used is untested; this can be viewed as potentially limiting the trustworthiness of the research study findings and conclusions.

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APPENDICES

APPENDIX A: ANALYSIS OF QUESTIONS AND RESPONSES

An Example

A.1 Students Perception Questions

Table S1 : Access to internet outside university

SRQ1A	Did you have access to the internet outside university? (2 years ago)	**هل لديك إمكانية الوصول إلى الإنترنت خارج الجامعة؟**
SRQ1N	Do you have access to the internet outside university? (Now)	**هل لديك إمكانية الوصول إلى الإنترنت خارج الجامعة؟**

SUMMARY STATISTICS

Item	SRQ1A	SRQ1N
Mean	2.25	2.4
Median	3.0	3.0
Maximum	3.0	3.0
Minimum	1.0	1.0
Std.Dev	0.908	0.875
Sums	401.0	427.0
Obsv	178	178

Table S1 shows the summary statistics for SRQ1. Using the Likert-scale values of 3 = yes, 2 = Not sure, and 1 = No, the table shows that the students have more access to the internet outside the university now than they had 2 years ago. This is proven by the mean of SRQ1N (*M = 2.4*) greater than that of the SRQ1A (*M = 2.25*). This is supported by SRQ1N's closeness of dispersion around the mean (*Std. dev = 0.875*) than that of SRQ1A (*Std. dev = 0.908*).

APPENDIX B: REPEATED MEASURES ANOVA TESTS

An example:

B.1 Repeated Measures ANOVA Tests

The repeated measures ANOVA tests were conducted on the 51 students' and 12 teachers' perception questions to show the effects of increasing ubiquity of technologies on how higher education students in Oman have changed their learning habits between two years ago and now. Repeated measures analysis of variances tests are best used when there is the need to know if there are significant differences between measures or perceptions observed at different time intervals on the same subject matter (Hinton, Brownlow, & McMurray, SPSS Explained, 2004).

The repeated measures ANOVA tests were initially conducted on the double responses of the 178 students and 37 teachers sampled to obtain the 102 and 24 Likert-scale data observation means and standard deviations for students and teachers respectively. 178 students were surveyed to respond to 51 questions while 37 teachers were surveyed to respond to 12 questions. The questions bothered on the respondents' perceptions on the introduction of technology in Omani higher education. This was followed by tests on the obtained means and standard deviations to obtain the overall outlook for both categories.

B.2 Results of Analysis

Set out in Tables B.1 to B.20 and Figures B.1 to B.4 are the results of the repeated measures ANOVA tests on the two main samples of students' and teachers' perceptions respectively.

Table B.1 and B.12 show the descriptive statistics of means and standard deviations for the students' and teachers' perceptions respectively.

B.2.1 – Students' perception.

The initial multivariate tests produced by SPSS version 28 on students' perceptions in Table B.2 with the F statistics analysis used Pillai's trace (V), Wilk's lambda (Λ). Hoteling's trace (T), and Roy's large root test (Θ) estimates all returned significant differences between students' perceptions two years ago students' perceptions now. Pillai's trace, Wilk's lambda, Hoteling's trace, and Roy's largest root tests are additional tests carried on multivariate and repeated measures ANOVA tests to show whether there was a significant departure from the assumption of homogeneity of data analysed (Field, 2005); Pillai's trace particularly is a positive valued statistics ranging from 0 to 1 and it shows how the effects of homogeneity or otherwise contributed to the model produced by the analysis (Glen, 2006). The four tests were used to further validate the predictive effect of the model generated by the analysis.

The results indicated that for two years ago: Pillai's trace (V = .957, $F(50,128)$ = 57.102, $p < .001$), Wilk's lambda (Λ = .043, $F(50,128)$ = 57.102, $p < .001$), Hoteling's trace (T = 22.306, $F(50,128)$ = 57.102, $p < .001$), and Roy's largest root (Θ = 22.306,

$F(50,128) = 57.102$, $p < .001$). For students' perception now, the results are Pillai's trace ($V = .189$, $F(1,177) = 41.333$, $p < .001$), Wilk's lambda ($\Lambda = .811$, $F(1,177) = 41.333$, $p < .001$), Hoteling's trace ($T = .234$, $F(1,177) = 41.333$, $p < .001$), and Roy's largest root ($\Theta = .234$, $F(1,177) = 41.333$, $p < .001$).

Mauchly's test of sphericity is a test to show whether the data distribution used for the repeated measures ANOVA test violated the assumption of sphericity. Sphericity refers to the condition where the variances of the differences between all combinations of related groups are equal (Zach, 2021). The sphericity test result in Table B.3 shows that the sample distribution for the students' perceptions violated the assumption of sphericity. Nevertheless, the Greenhouse-Geiser and the Huynh-Feldt were used to correct the effects of the violation by adjusting the degrees of freedom used to estimate the *F* statistical values in Tables B.4 and B.5, (Hinton, Brownlow, & McMurray, SPSS Explained, 2004). It is noted that the *F* values estimated using the two in Table B.4 all returned either $p = .000$ or $p < .001$, thereby indicating that the measures analysed were significantly different in both periods of observation (two years ago and now).

Table B.5 holds the overall results of the repeated measures ANOVA test for students' perception. The results revealed that the students' perception on the effect of technology on pedagogy and learning in Oman's higher education now is significantly different from the students' perception two years ago ($F(1,177) = 10632.944$, p ¸.001). The results of the multivariate tests (Table B.8 and Table B.11) corroborate the repeated measures ANOVA results in table B.5.

For the students' perception (multivariate tests table B.8) two years ago, Pillai's trace ($V = .957$, $F(50,128) = 57.102$, $p < .001$), Wilk's lambda ($\Lambda = .043$, $F(50,128) = 57.102$, $p < .001$), Hoteling's trace ($T = 22.306$, $F(50,128) = 57.102$, $p < .001$), and Roy's largest root ($\Theta = 22.306$, $F(50,128) = 57.102$, $p < .001$). All showing significance at the critical value of .05.

For the students. perception (multivariate tests table B.11) now, Pillai's trace ($V = .189$, $F(1,177) = 41.337$, $p < .001$), Wilk's lambda ($\Lambda = .811$, $F(1,177) = 41.337$, $p < .001$), Hoteling's trace ($T = .234$, $F(1,177) = 41.337$, $p < .001$), and Roy's largest root ($\Theta = .234$, $F(1,177) = 41.337$, $p < .001$). All showing significance at the critical value of .05.

Figures B.1 and B.2 also gave pictorial overviews of the significance of the difference in the two periods of measurements of students' perceptions.

Appendix C: Complete Instrument

Questionnaire for Students (Structured)

Please indicate your level of agreement with the following statements on a scale from 1 to 7, where 1 represents "Strongly Disagree" and 7 represents "Strongly Agree."

1. Technology has enhanced my learning experience in the classroom.

2. I regularly use technology for educational purposes outside the classroom.

3. I feel comfortable using digital tools and resources for my studies.

4. The availability of technology has improved my access to educational materials.

5. Mobile devices are an essential part of my learning toolkit.

6. Online platforms and resources have helped me collaborate with peers on academic projects.

7. I feel confident in my ability to navigate e-learning platforms and online courses.

8. Technology has positively impacted my academic performance.

9. I prefer using digital textbooks and resources over traditional print materials.

10. Social media platforms have facilitated informal learning and knowledge sharing among classmates.

[Questions 11-20 follow a similar format.]

Questionnaire for Teachers (Structured)

Please indicate your level of agreement with the following statements on a scale from 1 to 7, where 1 represents "Strongly Disagree" and 7 represents "Strongly Agree."

11. I integrate technology into my teaching practices on a regular basis.

12. Technology has enhanced my ability to engage students in classroom activities.

13. I receive adequate support and training to effectively use technology in my teaching.

14. Online platforms and resources have expanded my teaching repertoire.

15. I encourage students to use technology for collaborative learning activities.

16. The availability of technology has improved student participation and engagement.

17. I feel confident in my ability to troubleshoot technical issues during class.

18. Technology has positively impacted student learning outcomes in my courses.

19. I believe that e-learning platforms offer valuable opportunities for personalized learning.

20. I regularly incorporate multimedia content into my lectures to enhance student understanding

[Questions 21-26 follow a similar format.]

Questionnaire for Teachers (Open-Ended) [Qualitative]

Please provide your responses to the following questions in the space provided:

21. How do you perceive the role of technology in facilitating teaching and learning in your classroom?

22. What challenges do you encounter in integrating technology into your teaching practices?

23. How do you believe technology has influenced student engagement and participation in your courses?

24. In what ways do you think technology has impacted student learning outcomes?

25. What strategies do you use to promote effective use of technology among your students?

26. How do you envision the future of technology-enhanced learning in Oman?

[Questions 21-26 are open-ended and motivate a greater freedom of responses.]