UNIVERSITY OF KWAZULU-NATAL

Understanding the factors influencing the adoption of cloud computing in higher education during coronavirus disease: A case of University of KwaZulu-Natal

By

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A dissertation submitted in fulfilment of the requirements for the degree of

Master of Commerce

School of Management, IT and Governance

College of Law and Management Studies

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2023

DECLARATION

I Minenhle Zondi declare that

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ACKNOWLEDGEMENT

Firstly, I would like to thank Jesus Christ who is my Lord and saviour for His never-ending mercies upon my life. None of this would have been possible without Him because we plan, and He decides.

Edlozini lami ngithi boZondi, Nondaba, Gagashe, Nhlab'shile, Luqa, Bhambatha kaManciza, ubukhona benu ngiyabuzwa futhi ngiyabuhlonipha kakhulu empilweni yami.

To my supervisor, Dr Surika Civilcharran, thank you for being a voice of reason and my sounding board throughout this entire process. Your guidance, words of encouragement and the constant check-ins you provided me with have not gone unnoticed. I am blessed to have had you as my supervisor.

I want to express my deep gratitude to Nompilo Mchunu and Hlelo Zondi for volunteering their time to help me with data collection. To my friends thank you so much for always checking in on me and giving me courage to continue.

My utmost appreciation goes to my family above all else, as they have provided me with unwavering love and support throughout this entire journey. Your words of encouragement and video calls during my struggles with this dissertation are what got me up and fuelled me to try again and reach the end goal which was completing this master's degree. Inhliziyo yami isondelene kakhulu nani kwanga uNkulunkulu wethu anganilonda, anigcine bese enipha konke enikufisayo nenikucelayo kuyena.

To the love of my life Meluleki Madlala, thank you for being my constant source of strength. Thank you staying up with me all those late nights, advising, encouraging, supporting, and motivating me during times where I was at my lowest in this journey. Sthandwa sami ngiyabonga kwande.

Lastly, I dedicate this dissertation to my late grandmother Sizakele Yalezile Alvina Zondi, I would not be where I am today without you. Ngithi Ntombi ka Nkwebula ngiyabonga salukazi sami. You are dearly missed and loved, continue resting in perfect peace Chunu.

GLOSSARY OF ABBREVIATIONS AND ACRONYMS

BI- Behaviour Intention

CC- Cloud Computing

CCA- Cloud Computing Adoption

Covid-19- Coronavirus Disease

DOI- Diffusion of Innovation theory

EE- Effort Expectancy

FC- Facilitating Conditions

HEIs- Higher Education(al) Institutions

HSSREC- Humanities and Social Science Research Ethics Committee

IaaS- Infrastructure as a Service

ICT- Information and communication Technology

IT- Information Technology

NIST- National Institute of Standards and Technology

PaaS- Platform as a Service

PE- Performance Expectancy

PMB- Pietermaritzburg

SaaS- Software as a Service

SI- Social Influence

SSA- Sub-Saharan Africa

TAM- Technology Acceptance Model

TAM 2- Technology Acceptance Model 2

TRA- Theory of Reasoned Action

UB- Use Behaviour

UKZN- University of KwaZulu-Natal

UTAUT- Unified Theory of Acceptance and Use of Technology

ABSTRACT

Cloud computing (CC) as a model for internet-based service provisioning, enables the delivery and access of services based on dynamically scalable and virtualized resources (infrastructure, platforms, etc.). For higher education institutions (HEIs) cloud computing provides services anywhere and anytime, as a result of its scalability and pay-as-you-use approach. Although scalable processing and storage, data sharing, and anytime, anywhere access are some of the key advantages that CC may offer enterprises, there are also risks and barriers to adoption, and it is still in its infancy in developing nations.

The Coronavirus (Covid-19) pandemic, which struck the entire world in 2020, compelled institutions to alter their procedures and methods as a result of the social distancing laws that were put in place to stop the spread of Covid-19. The sudden surge of the Covid-19 pandemic caused a quick acceleration towards the adoption and use of CC in learning and education to ensure the continuation of classes. CC had a significant impact in fighting the epidemic and became a saviour for various fields including the education sector.

This study seeks to investigate the factors influencing the adoption of CC in HEIs during the upsurge of the Covid-19 virus. The research model utilised is the unified theory of acceptance and use of a technology (UTAUT). The study used a quantitative technique to identify the factors that influence the adoption of cloud computing through a questionnaire survey that was administered to a convenient sample at the UKZN Pietermaritzburg campus.

The study found that effort expectancy (EE), performance expectancy (PE) and social influence (SI) all positively influence the behavioural intention (BI) to use CC for learning purposes, with performance expectancy being the highest predictor of behavioural intention to adopt CC for students. Additionally, facilitating conditions (FC) and behavioural intention (BI) were also found to influence the actual sage of CC for learning purposes. These findings are useful as they give university's policymakers, designers insights into what factors are crucial when implementing CC to ensure the successful adoption by students.

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1.1 Introduction

In this chapter Cloud Computing (CC), and the role it plays on education is introduced. This chapter goes into greater information about the research problem that the study is trying to tackle. The research problem statement provides a discussion about how Higher Educational Institutions (HEIs) in developing countries are not fully utilising CC in their educational activities and look at the opportunities CC provides to HEIs. The study has four research questions it intends to answer and four supplementary objectives it wants to accomplish in order to address the research problem.

1.2 Background of Study

El-Sofany, Al Tayeb, Alghatani & El-Seoud (2013) posited that in the realm of information technology, CC is regarded as the fifth generation of architecture coming after mainframes (1970), client-server (1980), web (1990), and SOA (2000). In a nutshell, CC is nothing more than a group of highly scalable computers cooperating remotely to provide service to a customer over the Internet (Saidu & Sada, 2018). Compaq coined the term "cloud computing" in 1996, and Amazon.com popularized it when it debuted the Elastic Compute Cloud in 2006 (Saidu & Sada, 2018, p.1).

CC is “a modern technology that provides various resources of technology from servers, networks, storage, and various applications for large and small enterprises via the Internet or intranet” (Mohammad, Alwan & Abduljabbar, 2022, p.1). Instead of installing them on workstations, CC virtualizes resources, such as software applications, to allow for their distribution over the Internet (Ali, 2019b). Due to the fact that the entire computational process is handled by a distant server or cloud server, these resources can be accessed using any device with high-speed network connectivity from anywhere (Saidu & Sada, 2018). These services are offered to the user at a very cheap price on demand and are billed at the time when resources are released (Haris & Khan, 2018).

The three fundamental paradigms of cloud computing are Software as a service (SaaS), Platform as a service (PaaS), and Infrastructure as a service (IaaS) these models offer an alternative, cost-effective solution (Bittencourt, Goldman, Madeira, da Fonseca & Sakellariou, 2018). Public cloud, private cloud, community cloud, and hybrid cloud are the four cloud deployment options in addition to the cloud service models (Mell & Grance, 2011). Essentially, cloud deployment models show the various cloud environments that businesses, consumers, and organizations can choose from and can be distinguished by ownership, scale, and access (Modisane & Jokonya, 2021). In addition to the deployment and service models there are five cloud features which are on-demand self-service, broad network access, resource pooling, rapid elasticity, and measured service. These will be expanded on later in the following sections of the paper.

The literature has demonstrated that using CC technologies in place of conventional teaching methods would yield many benefits for HEIs (Karim & Rampersad, 2017; Rajesh, 2017; Saidu & Sada, 2018).

Some benefits of CC include reductions in the total costs of acquisition or ownership (TCO) of technology, software, and trained resources (Arkorful, 2019). “Despite the potential advantages of CC, adoption rates in HEIs are still quite low because of security concerns, particularly trust issues, which continue to be a key issue among the decision makers and users of CC” (Arkorful, 2019, p.1). Furthermore, according to Mohlameane & Ruxwana (2020) problems with public trust with CC services generate uncertainty and doubt about data security and privacy as well as a loss of control over data in the CC environment. Without a doubt, CC can resolve the aforementioned problems if it is utilized in higher education facilities. According to the study by Almajalid (2017), CC is inexpensive because it relies on a pay as you go structure and has no physical infrastructure to maintain. The idea was put forth that academics would benefit from ease of use, and IT workers would be more productive if they adopted CC (Al-Shqeerat, Al-Shrouf, Hassan & Fajraoui, 2017).

1.3 Research Problem

Almost all South African institutions have relied on face-to-face learning methods since the inception of higher education, from the colonial era to the post-colonial era (Mpungose, 2020). As science advances, the traditional method of teaching has been replaced by a more contemporary method of CC communication with pupils. To curb the spread of the Covid-19 virus which was originally discovered in China's Wuhan City in December 2019, a national lockdown was declared in 2020 by the president in South Africa. HEIs were consequently compelled to halt their in-person teaching and learning operations to implement social distancing and curb the spread of the virus (Agrawal, 2021). Universities were forced to innovate and come up with potential strategies, which included e-learning, as a result of the suspension of teaching and learning activities in academic institutions across the nation. However, the education sector encountered various difficulties in the process of implementing online teaching and learning modalities, as a result of the socio-economic challenges South Africans face (Armoed, 2021). According to WorldData.Info (2022) definition, "developing countries" are nations whose income, economic, and industrial growth are still considerably below average, and South Africa falls under this category as a developing country. “Developing countries have poor administrative and technical support, and limited staff development which prevents them from utilising new technologies effectively and integrating these into their education systems” Abbad (2021, p.7208). To assess the impact of CC in higher education: amidst Covid-19, Madhumitha, Rajbabu & Purswani (2021) surveyed 404 students across different universities in the South of India. The study found that it would be beneficial for universities to implement cloud solutions, as students are willing to use cloud technology due to its numerous benefits. The authors also emphasized the necessity for students and educational institutions that have not yet adopted the cloud to do so in order to gain access to information and

technological services more effectively and conveniently. “Particularly from features and benefits like access to sophisticated applications, reasonably priced cloud data storage, scalability, and flexibility of an e-learning platform” (Madhumitha *et al.*, 2021, p.93). Even while the usage of CC in HEIs is growing throughout the world, particularly in industry and education, little research has been done on how it may affect universities in South Africa (Moloja & Ruhode, 2020). Due to trust and security challenges, developing nations have not fully adopted cloud-based solutions (Abdulatif & Hamad, 2020). This has made it necessary to look at the factors influencing students’ adoption of CC at the UKZN PMB campus. Even after the epidemic has gone, understanding these elements may help in the development of more suitable plans for the use of CC services at the university.

1.4 Research Questions

The creation of the study's research questions was influenced by the UTAUT model, which serves as the theoretical framework for this investigation. A rigorous review and comparison of the eight models used to develop the UTAUT model by Venkatesh, Morris, Davis & Davis (2003) showed that it is the most useful model for gauging technology adoption.

- What is the students current usage of CC for learning purposes?
- What factors influence students’ intention to adopt CC for learning purposes?
- What is the behavioural intention of students to adopt CC for learning purposes?
- Which of the four constructs (PE, EE, SI & FC) has the most influence on students to adopt CC for learning purposes?

1.5 Research Objectives

- To determine the student’s current usage of CC for learning purposes.
- To determine factors influencing student’s intention to adopt CC for learning purposes.
- To determine the behavioural intention of students to adopt CC for learning purposes.
- To determine which of the four constructs (PE, EE, SI & FC) has the most influence on students to adopt CC for learning purposes.

1.6 Overview of Theoretical Framework

In this research, the Unified Theory of Acceptance and Use of Technology (UTAUT) is adopted as the theoretical model, and it will be further developed and explained in chapter 2. The UTAUT was created as a framework by combining eight popular adoption theories and models (Jaradat, Ababneh, Faqih & Nusairat, 2020). Venkatesh *et al.* (2003) employed the UTAUT model, which spans several domains, to comprehend acceptance behaviour in people. “The UTAUT was proposed on merits for investigating factors responsible for enhancing the intentional behaviour to adopt cloud computing services because due to its richness and high explanatory power in unlocking and understanding the key drivers of technology adoption” (Jaradat *et al.*, 2020, p.8285). Wijaya, Cao, Weinhandl, Yusron & Lavicza (2022) posited that when compared to other models, this model can account for up to 70% of the variance (R2

= 70) in BI and 40% of the actual use. For this study, PE, SI, EE, and FC were all investigated as drivers of acceptance behaviour.

1.7 Significance of Study

According to the investigator's understanding and what is evident from the literature, CC use in South Africa HEIs has not been widely accepted. This was particularly apparent during the first "hard lock down," when all academic activities were banned throughout South Africa's academic institutions in an attempt to stop the advancement of the Covid-19 virus. Due to a shortage of infrastructure, some academic institutions were unable to continue their administrative, managerial, and teaching activities during the lockdown (for a few weeks). For institutions that have the required infrastructure, the expense of operation and upkeep has emerged as a critical concern, and they also face other difficulties like a loss of privacy and flexibility. In this research we will look into the factors affecting the adoption of CC at HEIs in South Africa. Decision-makers may be enlightened on the value of CC in tertiary institutions by the study's findings. The results of this study may also help management make good decisions regarding the delivery of high-quality education, as well as improve teaching and learning efficiency and effectiveness, as well as other administrative and managerial tasks.

1.8 Dissertation Structure

Chapter 1: Introduction

The first chapter introduces the subject by reviewing CC's background. This chapter includes discussions of the problem statement, research questions, and research objectives. Finally, the chapter further addresses the study's significance. It also includes a brief explanation of the study's theoretical background.

Chapter 2: Literature Review

The literature review chapter of this research presents the current studies on the adoption of CC in Higher Education Institutions (HEIs). The first section of this chapter provides a general overview of CC, including the factors that affect its adoption, the obstacles and benefits associated with its implementation in HEIs. Additionally, various technology adoption theories are discussed at the end of the chapter. Furthermore, the impact of Covid-19 on education is also included in the discussion.

Chapter 3: Research Methodology

In this chapter, the researcher describes the methods utilized in conducting this study. The research design, research philosophy, research approach, research method, and research strategy are all components of the research methodology that are elaborated upon. The chapter also covers sampling methods, data collection, and data analysis techniques.

Chapter 4: Findings and Discussion of Results

This is the data analysis chapter which details all the findings of the research study being undertaken. The chapter first discussed the response rate and the reliability tests and validity. This is followed by the descriptive analysis which details the demographics of the participants. This chapter further examines the responses collected based on the constructs of the framework employed in the study. Additionally, the chapter discusses the normality tests conducted and the correlation analysis of all the constructs in the framework. Finally, it presents a discussion of the results and concludes the chapter.

Chapter 5: Conclusion and Recommendations

Chapter 5 serves as the conclusion of the study and presents the limitations and recommendations for future research. The chapter highlights the findings of the study and summarizes the conclusions drawn from the data. Furthermore, the chapter identifies the limitations of the study and provides recommendations for future research to address the gaps and limitations identified.

1.9 Chapter Summary

This chapter introduced the study being undertaken by discussing the background of the study, highlighting the research problem, research questions and objectives. This chapter also discussed the theoretical framework and dissertation structure.

2 CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

The literature review chapter provides insights of where higher education is with regard to the adoption of CC by discussing existing literature from studies previously conducted. An overview of the various concepts of CC, including the definition, cloud deployment models, cloud service models and the characteristics of cloud will be given. Furthermore, the literature for the adoption of CC from a perspective of developing and developed countries is reviewed. Finally, the chapter explores the role of CC in higher education, the benefits, and challenges of cc in HEIs and finally how the COVID-19 pandemic accelerated the digital transformation of HEIs.

2.2 Cloud Computing Overview

By no means is CC a novel idea in the field of information systems; rather, it is an evolutionary idea that has its roots in grid computing, which tried to use parallel computing to solve complex problems (Modisane & Jokonya, 2021). The phrase "cloud computing" was first used for commercial purposes in 1999 when www.salesforce.com launched its business applications and after salesforce, another significant online retailer, amazon.com, followed in 2002 when it launched its cloud-based storage services (Isak, Ahmed & Elamin, 2018). Due to "the growth of the Internet and the development of mobile computing after the dot-com bubble, the early 2000s saw a widespread recognition of the existence and importance of CC for organizations" (Patala, Kadyamatimba & Madzvamuse, 2019, p.1). Due to the increasing growth of cloud services, CC nowadays enables a massive number of operations in a matter of seconds, in contrast to prior systems where the number of transactions was constrained (Surbiryala & Rong, 2019). CC has gained widespread adoption in both, the public and private sectors, as a result of the usefulness of its services, which have the ability to provide convenience on a number of levels (Alhenaki, Alwatban, Alamri & Alarifi, 2019). However, cloud customers and cloud service providers place a high priority on the security of the offered services (Alhenaki *et al.*, 2019).

CC has historically developed from grid computing to utility computing to SaaS to CC (Govender, 2016). Grid computing, utility computing, and autonomous computing are frequently mistaken with CC (Surbiryala & Rong, 2019). Grid computing is the simultaneous application of the resources of many computers in a network to one problem, usually a scientific or technological problem that requires many computers (Kulkarni, Solanke & Gupta, 2013). Grid computing supports parallel computing, which is a communication style in which multiple calculations are performed simultaneously, although its utility is best suited for heavy workloads (Govender, 2016). An autonomous computing system is one that is capable of managing itself (Surbiryala & Rong, 2019). Utility computing "is a computing technology that provides computing resources and management of infrastructures like storage, applications, and computing power available to customers" (Pal, 2021, p.3). The key advantage of utility computing is the reduction of capital and operating expenses (Govender, 2016). By introducing "pay only for what

you use approaches, utility computing enables businesses to hire computing resources as needed" (Govender, 2016, p.13).

Literature has provided different definitions for CC from various scholars. Alshamaila (2013) highlighted that definitions of CC have already seen numerous changes and would undoubtedly experience more changes. "Different definitions of CC show different visions about cloud computing from the different standpoints of different stakeholders such as academics, architects, consumers, developers, engineers and managers" (Alshamaila, 2013, p.81). Below are some of the definitions of CC:

Table 2-1: Cloud Computing Definitions

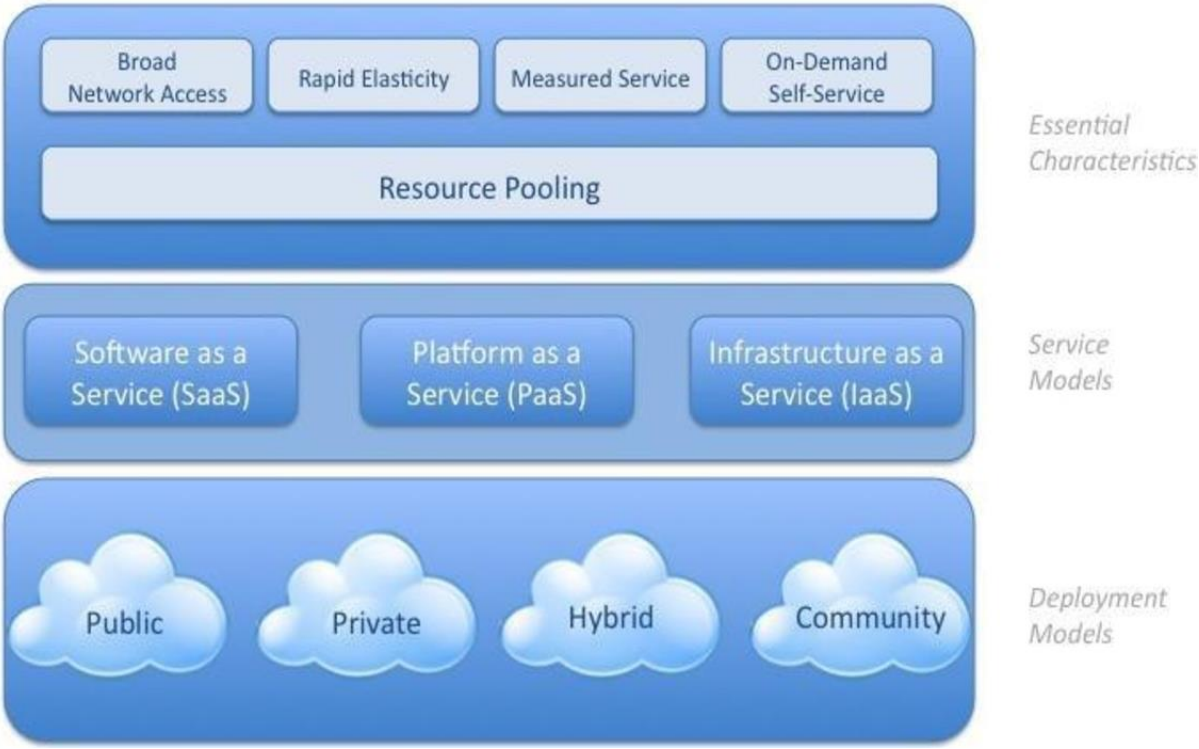
Author	Definition
Vaquero *et al.* (2008)	Clouds are a large pool of easily usable and accessible virtualized resources (such as hardware, development platforms and/or services. These resources are dynamically reconfigured to adjust to a variable load (scale), allowing also for an optimum resource utilization.
Mohammad *et al.* (2022)	Cloud computing is a modern technology that provides various resources of technology from servers, networks, storage, and various applications for large and small enterprises via the Internet or Intranet .
Al-Samarraie & Saeed (2018)	Cloud computing is defined as a scalable Information Technology (IT) enabled capability in which resources of the computing infrastructure are provided as services over the Internet.
Maaref (2012)	Cloud computing as a model for enabling networks users on-demand access to a shared pool of configurable computing resources that can be rapidly provisioned and released to the client without direct service provider interaction.
Jaalen (2018)	Cloud computing is a model for enabling convenient, on-demand network access o a shared pool of configurable resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.
Buyya *et al.* (2012)	A type of parallel and distributed system consisting of a collection of interconnected and virtualized computers that are dynamically provisioned and present as one or more unified computing resource based on service-level agreements established through negotiation between the service provider and customer.
Singh & Sehaan (2012)	Cloud computing is an increasingly important virtualization technology that uses the Internet and central remote servers to offer the sharing of resources that include infrastructure, software, applications, and business process to fulfil the elastic demand in the market environment.

Table 2.1 above gives definitions of CC as state by various researchers. Despite the fact that there are numerous definitions offered for CC, the National Institute of Standards and Technology (NIST) of the US Department of Commerce provides the most popular and accepted definition. NIST defines CC as "a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction" (Mell & Grance, 2011, p.2).

Studies have presented three CC service models; Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS), four CC deployment models; Public cloud, Private cloud, Hybrid cloud & Community cloud and five characteristics; On-demand self-service, Broad network access, Resource pooling, Rapid elasticity and Measured service (Mell & Grance, 2011; Al-Shqeerat *et al.*, 2017; Alharthi, Alassafi, Alzahrani, Walters & Wills, 2017; Bello, Oyedele, Akinade, Bilal, Davila Delgado, Akanbi, Ajayi & Owolabi, 2021). Figure 2.1 below visually depicts the CC framework and it was developed by (Mell & Grance, 2011). Three levels make up the framework; the top layer symbolizes the four cloud deployment models, the middle layer the three cloud service models, and the bottom layer the five fundamental layers.

Figure 2-1: Cloud Computing Framework

Source: (Mell & Grance, 2011).



2.2.1 Cloud Service Model

Studies have presented three cloud service models, namely Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS) (Mell & Grance, 2011; Agrawal, 2021; Alhomdy, Thabit, Abdulrazzak, Haldorai & Jagtap, 2021). To connect these services to the many advantages and grasp their part in the adoption of CC as a technology, it is crucial to have a thorough understanding of these services (Osembe, 2015). Table 2.2 below represents the common cloud service models and main users at HEIs. Column one names the model, column two gives a description of the model and finally column three lists the key users of these cloud service models ate HEIs.

These cloud service models reflect various layers of the CC architecture and are categorized based on the computing needs of the clients (Alshamaila, 2013). The cloud service models explain how the cloud environment is set up to satisfy the needs of various users (Shoniwa, 2021).

SaaS refers to a service where customers are given the opportunity to access and utilize the provider's applications, but the cloud service provider is in charge of running and maintaining the operating system, application software, and other resources (Mell & Grance, 2011; Rashid & Chaturvedi, 2019). Additionally, "SaaS was developed with the needs of end users in mind, and allows end users the ability to interact with web-based applications over the internet without having to install applications on their computers" (Modisane & Jokonya, 2021, p.786). SaaS is linked to a number of advantages, including security, quick scaling, software compatibility, accessibility on a worldwide scale, and dependability (Almajalid, 2017). Examples of businesses that offer this kind of platform include Salesforce.com, Intuit-QuickBooks, and Google Apps (email, calendar, and documents) (Attaran, Attaran & Celik, 2017). Haris & Khan (2018); Rashid & Chaturvedi (2019) noted that the following are some of the benefits of SaaS:

- Quick scalability
- Accessibility over the Internet from any area
- Eliminates concerns about infrastructure
- Customized service levels are available
- Combined upkeep and support
- SaaS offers numerous applications for users to utilize
- Eliminates the need to install a program
- Support a large number of users simultaneously

PaaS is a service that enables users to install their own or purchased apps into the cloud infrastructure while having the service provider deliver, run, and maintain system software (i.e., the operating system) and other computing resources (Mell & Grance, 2011; Rashid & Chaturvedi, 2019). Without having to install base software on their computers, PaaS enables application developers to create, test, launch,

host, and maintain web applications and software through platforms online (Modisane & Jokonya, 2021). Lack of software upgrades, lower risk, and easier deployment are some features of PaaS (Almajalid, 2017). Google App Engine, Windows Azure, and Force.com are some examples of businesses that offer this kind of platform (Attaran *et al.*, 2017). Some of the benefits of PaaS mentioned by Haris & Khan (2018); Rashid & Chaturvedi (2019) are:

- Community – When creating cloud apps in a PaaS environment, there are typically many people engaged
- No further updates are necessary- Organizations are no longer required to update or upgrade the infrastructure software
- Cost savings – Since there is no upfront investment required for hardware and software, companies are exposed to less risk
- Pay to use the facilities
- Architecture with multiple tenants
- Ensure consistency and safety

IaaS is a CC service that enables users to install and execute whatever application they desire, with the use of virtualized computer resources provided by the cloud service provider (Mell & Grance, 2011; Rashid & Chaturvedi, 2019). IaaS exposes customers to pricey technologies that are out of their price range and makes IT infrastructure management more affordable, allowing cloud users to rent or use the services that best meet their needs (Modisane & Jokonya, 2021). "IaaS features include platform virtualization, dynamic scalability, Internet connectivity, automated administrative activities, and lower overall ownership costs that lower capital expenditures" (Almajalid, 2017, p.2). Examples include CenturyLink, Rackspace, and Amazon Web Services (Attaran *et al.*, 2017). (Haris & Khan, 2018); Rashid & Chaturvedi (2019) noted the following as some of the benefits of IaaS:

- Decreases the price of capital investments as there is no upfront payment needed for infrastructure
- Clients pay for the services they require
- Access to business-grade IT infrastructure and resources.
- Users can adjust the resources at any time to meet their needs by scaling them up or down. Offers resources as a service
- Pay IaaS services based on usage
- Dynamic scaling is supported

Table 2-2: Common Cloud Service Models and Key Users at HEIs

Source: (Ali, Wood-Harper & Ramlogan, 2020, p.415)

Service Model	Description	Key Users
SaaS	SaaS entirely depends on the internet where applications are deployed and available on-demand. End-users can access applications using the browser or by using an interface. Subsequently, application services offered to the end-user on-demand through software. This feature enabled end-user to deploy the services quickly, which brings ease of use and monetary benefits. Many CSP corporations in the world offering these types of platforms such as GoogleApps (email, google docs, and calendar), Salesforce, NetApp, ServiceNow, and GotoMeeting.	Faculty, Staff, Students, classes, and Admin Department
IaaS	This is a virtual platform that allows end-users to deploy their applications on cloud infrastructure and use services such as networking, storage, database, backup, security, and other resources. This platform gives full control to the user over operating systems and deployed applications. Many companies in the world provide these types of platforms such as AWS, Rackspace, AttendaRTI, Amazon EC2, and CenturyLink	Servers, Data Storage, IT Department, and Researchers
PaaS	This is a platform-based service having a suite of cloud services that provides end-users to develop, execute, manage, and integrate on-premises and cloud-based applications and services. This feature offers no waiting time required for the deployment of appropriate applications (hardware and software). End-user can build applications by utilizing the platform and using the tools, languages, and services supported by CSP. Many companies in the world provide these types of platforms such as GoogleAppEngine, Azure, AWS, OCP, and Salesforce.	Execution, Database, Researchers, and Developers

2.2.2 Cloud Deployment Models

There are four proposed deployment models for cloud services, each with variations that addressed different requirements. The types of exclusive and non-exclusive methods of offering cloud services to clients are used to categorize different cloud deployment models (Rashid & Chaturvedi, 2019). The four cloud deployment models are explored below:

The **public cloud,** as the name states the infrastructure is freely accessible to the general public (Agrawal, 2021). Attaran *et al.* (2017, p.23) reported that "the cloud infrastructure is made available to the general public or a large industry group and is owned by an organization selling cloud services". This model improves economies of scale since the customer does not need to set up any resources beforehand instead, they can use network connections to get resources from the public cloud whenever they are needed (Mwamalangala, 2020).The key advantages of public cloud are its ease of use, low cost, scalability, availability & reliability, pay as per use and freedom of self-service (Al-Harthy & Al-Badi, 2014; Haris & Khan, 2018).

The **private cloud** model is provisioned for exclusive use by a single user / organisation (Mell & Grance, 2011; Alharthi *et al.*, 2017; Saidu & Sada, 2018). Due to the fact that all data is saved on the organization's private servers, this improves security, privacy, and reliability (Mwamalangala, 2020). The primary feature of this model is the involvement of a particular and clearly defined cloud environment where only the specified clients can work (Mwamalangala, 2020). Haris & Khan (2018, p.635) state that "the organization's control over the services results in improved security". Benefits of private cloud are high level security, reusability of existing resources and full control for customization (Haris & Khan, 2018).

A c**ommunity cloud** deployment, is a cloud hosting that is shared and mutually owned by numerous businesses in a certain community, such as trading companies, banks, or gas stations (Almajalid, 2017). Attaran *et al.* (2017, p.23) state that "the cloud infrastructure is a shared cloud computing service environment that is available to a limited set of organizations or employees (such as banks or heads of trading firms)".The infrastructure may be located on or off site, and it may be managed, owned, and controlled by one or more community organizations (Mwamalangala, 2020). Haris & Khan (2018) stated that some benefits of community cloud are lower cost compared to private cloud, limited users, and high security.

A **hybrid cloud** includes two or more of the following cloud types: private, public, and communal. These cloud models are separate entities, but they are linked by technology that allows applications and data to be moved between them (Olaloye, Adeyemo, Edikan, Lawal & Ejemeyovwi, 2019; Rashid & Chaturvedi, 2019). Some benefits of hybrid cloud are cost reduction, high availability and more security (Haris & Khan, 2018).

Table 2.3 below represents the four cloud deployment and compares them according to different attributes. This table provides a detailed summary which can assist decision makers at HEIs be able to choose the proper deployment model to implement in their respective universities.

Figure 2-2: Comparison Between Cloud Deployment Models

Source: (Haris & Khan, 2018, p.636)

Deployment Model / Attribute	Public Cloud	Private Cloud	Hybrid Cloud	Community Cloud
Ownership	Owned by customers	Owned by single organization	Partially owned by Service Provider and partially by consumer	Owned by two or more organizations which has common goal
Performance	Low to medium	Excellent	Good	Very Good
Setup cost of building datacentre	Low initial cost	High	Medium	Varies from number of organizations
Used by	Anyone can access	Limited people can access	Medium accessibility	Depend upon number of cooperatives
Security	Less	Highest	Medium	High
User's control	Limited control	Full control	Full control over private part and limited at public part	High control but limited by community policies
Maintenance cost	Lowest	Highest	Moderate	High
Space required	Very low	Very large	Medium	Depends on number of cooperatives
Workload	Normal workload with short spikes in demand	Not suitable for handling large workload	Highly dynamic or changeable	Suitable for handling large workload
Size of Datacentres	Around 50,000s	Around 50,000s	Less than private cloud	Public cloud>15,000> Private cloud
Virtualization	Resource utilization is optimized via server virtualization	Resource utilization efficiency gains through server virtualization	Resource utilization is optimized via server virtualization	Resource utilization efficiency gains via server virtualization
Reliability	Medium	Highest	Medium	High
Cloud Bursting	Not supported	Not supported	Supported	Not supported
Example	Amazon EC2	Microsoft Azure	Rackspace Hybrid cloud	Microsoft government community cloud

2.2.3 Cloud Essential Characteristics

The NIST as defined by Mell & Grance (2011) has proven to be the benchmark for the CC characteristics. Most literature Adendorff & Smuts (2019); Ali (2019b); Ali (2020); Abdullah & Al-Khlaifawi (2021) that was reviewed took the characteristics listed in the study by (Mell & Grance, 2011). The following are the five CC characteristics as outlined:

On-demand self-service: For this characteristic "a consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service provider" (Mell & Grance, 2011, p.2). Without interacting with the service provider directly, a client can unilaterally request computational resources or services from them, for example storage (Saidu & Sada, 2018). Additionally, it suggests that users of cloud services can autonomously define and adjust computational capabilities, such as server time, the amount of data kept in the cloud, and the speed at which data is accessed and processed, without the assistance of the service provider (Arutyunov, 2012). With the help of this service, HEIs stakeholders can access several resources (such as email, storage, and applications) at any time and from any location (Ali, 2020).

Resource pooling: In resource pooling "the provider's computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand" (Mell & Grance, 2011, p.2). Additionally, "it provides the ability to share information resources, such as computer network, server, operating system, database, and computer software, between multiple cloud users" (Aydin, 2021, p.2). This service's primary goal is to make it possible for HEI stakeholders to utilize shared cloud resources via networks in accordance with their needs (Ali, 2020).

Broad network access: In this characteristic "capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, tablets, laptops, and workstations)" (Mell & Grance, 2011, p.2). Standard access techniques and protocols are used to establish this ubiquitous access (Al-Shqeerat *et al.*, 2017). Stakeholders of HEIs "such as students, academic staff, and other key stakeholders can access network resources by using various devices" (Ali, 2020, p.414).

Rapid elasticity: Can be defined as " capabilities that can be elastically provisioned and released, in some cases automatically, to scale rapidly outward and inward commensurate with demand" (Mell & Grance, 2011, p.2). This multi-tenant strategy's virtualization technology enables resources to be dynamically assigned and reassigned in response to cloud users' demands (Al-Shqeerat *et al.*, 2017). This service "enables the HEIs stakeholders to process, utilize and adjust the cloud resources to meet the requirements according to their demand" (Ali, 2020, p.414).

Measured service: Is defined as "cloud systems that automatically control and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth, and active user accounts)" (Mell & Grance, 2011, p.2). The report gathered from tracking the usage of cloud resources provides transparency for both the user and the service provider (Al-Shqeerat *et al.*, 2017). This service introduces measured services that can later be updated in accordance with HEIs' requirements, enabling the main stakeholders in HEIs to automatically control and enhance the usage of resources (Ali, 2020).

2.3 Cloud Computing in Developing Countries

The term developing countries is frequently used to refer to nations that are routinely ranked lower in a variety of taxonomies (M'rhaouarh, Okar, Namir & Chafiq, 2018). Abali, Nabie & Dike (2019) concurs that countries that have not accomplished a specific level of development in terms of structural improvement and transformation are referred to as "developing," "underdeveloped," or "less developed". Due to a lack of high-performing technology infrastructure and cultural disparities in how new technologies are perceived in different cultures, countries in the Sub-Saharan Africa (SSA) region have experienced limited progress and integration into the global economy (Sabi, Uzoka, Langmia, Njeh & Tsuma, 2017). The current state of the adoption and CC services differs from developed countries to underdeveloped nations. The advanced nations are well ahead of the low-and-middle-income nations in terms of adoption and use of CC, and businesses and governments there are already utilizing it to improve service delivery and performance (Senyo, Effah & Addae, 2016).

Developing nations have historically lagged behind developed nations in adopting technical innovation and this has nothing to do with established intermediate technologies, but rather with a variety of factors that affect adoption and utilization of sophisticated technology (Sabi *et al.*, 2017). In the same vein, Sabi *et al.* (2017) posited that due to different impediments, developing countries have frequently lagged behind in the drive for technology diffusion, acceptance, and implementation. These impediments include, knowledge gaps, lack of education, high costs, restrictive government regulations, user reluctance, and security issues to name a few (Sabi, Uzoka, Langmia & Njeh, 2016).

Despite developing nations being at the infancy stages of CC adoption there has been movements observed and studies conducted where various HEIs were seen open to the idea of adopting CC. Samyan & St Flour (2021, p.146) posited that "nowadays, many institutions, policy makers and administrators in the educational field want to adopt and integrate cloud-based technology to support lifelong learning". Madhumitha *et al.* (2021) conducted a study to assess the impact of cloud in higher educational institutions on e-learning during Covid-19 pandemic in Mauritius. According to the study's test results, more than 60% of undergraduate, graduate, and PhD students were aware of and eager to use CC in their education. According to Qasem, Abdullah, Jusoh, Atan & Asadi (2019) who studied the adoption of CC in HEIs in Malaysia, CC technology affects how teachers, educators, and HEIs conduct

their job. According to a review by Adamu (2021) on the advantages of CC in education in Nigeria, it was found that because of CC educational institutions may now concentrate more on activities like research, teaching, and learning rather than IT infrastructure.

Al-Hajri, Echchabi, Ayedh & Omar (2021) undertook an investigation into the acceptance of CC systems in the higher education sector in light of the Covid-19 outbreak in Oman. The study included a sample of 200 respondents from the best colleges in Oman and utilized the Partial Least Square (PLS) method to analyse the data. The results from the study by Al-Hajri *et al.* (2021) showed that perceptions of CC usability, utility, dependability, and responsiveness all have a significant role in how it is used in this situation. These results are very significant, because they give higher education institutions and CC suppliers information on the key traits and elements that should be stressed in order to grow and improve the use of these systems among university students (Al-Hajri *et al.*, 2021).

2.4 Factors Affecting the Adoption of Cloud Computing

Hussein Alghushami, Zakaria & Mat Aji (2020) investigated the factors influencing CC adoption in HEIs in Yemen. The 38 universities across the nation were surveyed, and the target respondents were people who were knowledgeable with the IT structures, environmental contexts, adoption policies, and decision-making processes at each school. 433 questionnaires were distributed across the respondents from the 38 universities. The study used the Technology Organization Environment (TOE) model, culture was added as a moderating component in a model based on the extended TOE model, which was then looked at and confirmed using the PLS-SEM analysis. The results indicate that "relative advantage, reliability, compatibility, security, technology readiness, top management support, regulatory policy and competitive pressure have positive significant impacts on the cloud computing adoption" (Hussein Alghushami *et al.*, 2020, p.1).

Jaradat *et al.* (2020) explored CC adoption in a HEI. The study used a modified version of the UTAUT model which included Trust to analyse the factors influencing people's intentions to adopt CC in developing nations. The results obtained in the study showed that "performance expectancy, effort expectancy, social influence, and trust factors have positively important effects on intention to adopt cloud computing" (Jaradat *et al.*, 2020, p.8298). At the same time, it was demonstrated that the presence of facilitating conditions had a positive and highly significant effect on the actual usage.

Motema & Appiah (2019) administered a study to assess the elements affecting the acceptance of CC in a South African hospital. The study was conducted at Mankweng hospital, and the 50 participants used in the study were staff members from the finance, human resources, information technology and patient affairs departments within the hospital. The hospital's usage of the cloud is influenced by the availability of CC services, the unreliability of internally supplied IT services, and the requirement for data backup (Motema & Appiah, 2019).

In a study conducted by Rastogi, Verma & Sushil (2018) to determine factors influencing cloud services adoption in India from the city of Dehradun, a sample of 379 respondents was randomly chosen. The sample includes a wide range of respondents, including businesspeople, housewives, professors, students from management and engineering institutes, IT sector workers, and representatives from other private firms (Rastogi *et al.*, 2018). Using the UTAUT model, it was found that Behavioural Intentions (BI) is positively affected by Performance Expectancy (PE), Effort Expectancy (EE) and Social Influence (SI). Further, Facilitating Conditions (FC) has a direct positive effect on use behaviour (UB). Also, "Intention to adopt cloud services influences the actual use of CC services Use Behaviour (UB) positively" (Rastogi *et al.*, 2018, p.348).

Almaiah, Alamri & Al-Rahmi (2019) applied an extension of the UTAUT framework to explain the students' adoption of mobile learning system in HEIs. The data was obtained from 697 Jordanian students who answered an online survey from five different universities. In this study, it was found that "other factors such as perceived compatibility, perceived awareness, perceived information quality, perceived trust, availability of resources, perceived ability to use, self-efficacy, perceived security, performance expectancy, effort expectancy and facilitating condition significantly affected the acceptance of mobile learning" (Almaiah *et al.*, 2019, p.1746).

2.5 Cloud Computing in Higher Education

Due to its services-oriented design, unique features, and benefits, CC has become more and more well-liked by businesses and customers worldwide (Jaradat *et al.*, 2020). This growth in popularity of CC has also reached the educational sector. Education institutions have also gotten behind the effort to integrate CC into their daily operations (Noor, Naaz Mir, Bt. Nordin, Anwar, Islam Mattoo, Islam Khan & Olanrewaju, 2017). CC in HEIs has proven to be advantageous for both students and lecturers by enabling the storage of enormous amounts of data, simultaneous project work, and resource sharing (Qasem, Asadi, Abdullah, Yah, Atan, Al-Sharafi & Yassin, 2020). Jaradat *et al.* (2020, p.8286) noted that "the technology of CC has been tailored to deliver enhanced services that have become increasingly available and adequately stable for both the business world and academia, as well as providing faster on-demand infrastructure and data structured and processed for immediate consumption". The capacity to quickly offer a variety of on-demand, affordable services has been made possible through CC for HEIs (Ali, 2020).

Kayali & Alaaraj (2020, p.2) stated that "universities, especially those in developing countries, struggle to provide the quality of information and communication technology (ICT) required to support the expansion of learning, teaching, research, and other development activities due to a number of issues". HEIs must adhere to a specific set of ICT standards in order to stay abreast of technology advancements and upgrade their services to reflect the current technological landscape (Kayali & Alaaraj, 2020). The use of CC can help to reduce these expenses because HEIs have large expenditures associated with

maintaining their infrastructure, purchasing hardware and software, and operating their universities (Idowu & Osofisan, 2012; Rao & Challa, 2013; Attaran *et al.*, 2017; Kayali & Alaaraj, 2020). The adoption of CC technology has been suggested as a way to reduce the operational costs of colleges, because it offers users improved IT and increased availability, as well as reliability of these services from anywhere at any time with the benefit of paying per usage (Kayali & Alaaraj, 2020).

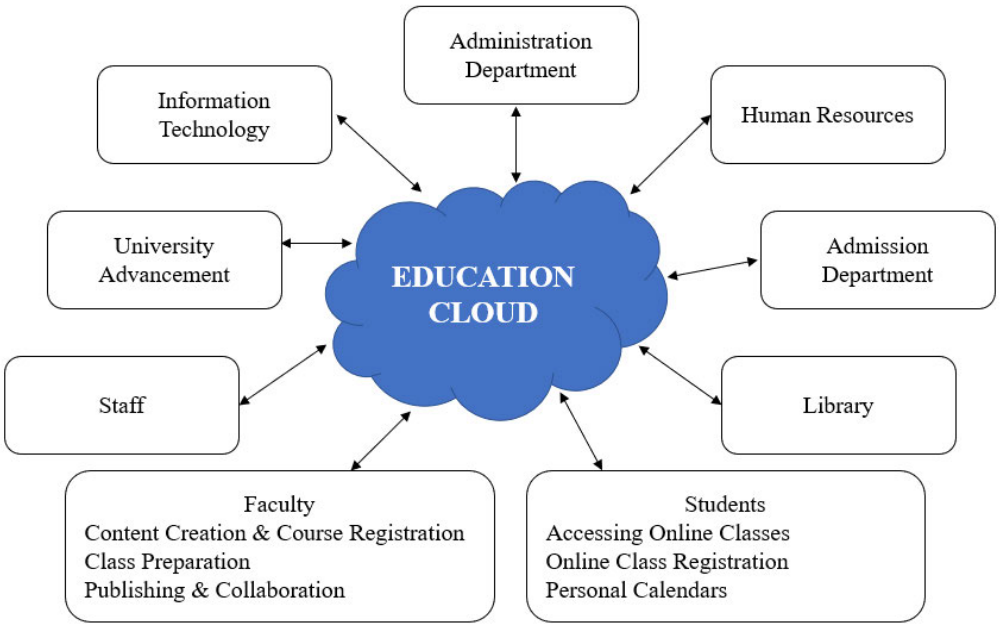
CC has made it simple for HEIs to offer a range of on-demand, affordable services (Ali, 2020). In order to meet their service demands for material supply, management, communications, and collaboration throughout time, the majority of HEIs worldwide are becoming more and more dependent on contemporary ICT (Ali, 2020).

The move to CC for many educational institutions started with the outsourcing of their student email provider, and in many countries, Google and Microsoft offer free email services to the educational sector (Jaleel, 2018). The "daily use of these affordable services by important HEI stakeholders supports learning, online class access, online registration, social interaction, content creation, course design, and class preparation" (Ali, 2020, p.415).

Figure 2.2 illustrates how various university customers and departments may leverage cloud computing infrastructures' services. The importance of figure 2.2 is that it shows that cloud services are not only advantageous or used by just students and lectures even different departments within the university such as administration and human resources can benefit from cloud services in achieving their day-to-day tasks.

Figure 2-3: Cloud Computing Services in HEIs

Source: (Attaran *et al.*, 2017, p.25)



2.6 Cloud Computing Challenges in Education

Due to its relative infancy and the underdeveloped cloud services market, CC for higher education faces a number of difficulties (Qassim, 2020). The literature has identified a number of obstacles to the use of CC in education (Nordin, Mir & Noor, 2017; Ali, 2019a; Olaloye *et al.*, 2019; Qasem *et al.*, 2019).

Security and Privacy

Data security is a crucial issue that must constantly be kept in mind. Organisations are hesitant to pay a vendor for a guarantee of business data protection (Rashid & Chaturvedi, 2019). Hackers may gain access to data on the cloud, because CC involves the central storage of data, especially sensitive data (Olaloye *et al.*, 2019). Many organizations prefer information that is inside to the organization in their control rather than external information the organization cannot control (Olaloye *et al.*, 2019). Similarly, Al-Shqeerat *et al.* (2017, p.26) noted that "some institutions still prefer to store their critical data into own repositories instead of moving them to a remote cloud".

Compliance

Regardless of where the applications or data are hosted, institutions must adhere to security requirements, because they are responsible for maintaining data security and integrity (Ali, 2019a). Rashid & Chaturvedi (2019) noted that HEIs are concerned of the regulatory and compliance requirements that various nations impose, as some of these nations forbid the storage of client personal data outside of their state or nation.

Reliability

Olaloye *et al.* (2019) Reliability is another contributing factor in the slow adoption of CC, as educational institutions are concerned that a system failure could have a serious negative impact on their facilities. In addition, Almajalid (2017) stated that reliability is another issue that cloud users and businesses must deal with. For instance, in 2009, a Google webmail service outage prevented more than 110 million users from using Gmail for three hours.

Poor Network Infrastructure

Olaloye *et al.* (2019) suggested that another issue with the adoption of CC is the absence of proper network responsiveness, since it is difficult to deliver complex services over a network with insufficient bandwidth. Noor *et al.* (2017) also noted that the use of ICTs in emerging nations has consistently been significantly impeded by the lack of suitable network infrastructure.

Unreliable Internet

Almajalid (2017) suggests that most HEIs cannot successfully adopt and implement CC as they lack sufficient bandwidth. In the same vein Noor *et al.* (2017) noted that the reliability of the Internet is one of the main obstacles stopping Southern Africa from adopting the cloud widely. Being able to depend on the Internet is necessary for the cloud's services to function well as the cloud requires rapid and dependable Internet. Poor Internet connectivity, outdated infrastructure, a shortage of trained labour, and lack of government support were some of the issues affecting the adoption of CC, according to a study by Moloja & Ruhode (2020).

2.7 Benefits of Cloud Computing in Education

Numerous advantages that prove beneficial in the adoption of CC have been identified through research. According to Ali (2019b), CC use in educational settings enhances high-quality education which is provided at a low cost globally. Additionally, Almajalid (2017) discovered that CC improves accessibility and convenience due to the fact that users can quickly access the cloud from anywhere using a variety of devices (such as smartphones, tablets, laptops, etc.). Olaloye *et al.* (2019, p.3168) stated that another "advantage of CC adoption in educational institutions is diversified learning, as students are exposed to a wider range of software tools and other pertinent information, the learning environment becomes more efficient and productive". Time is a big concern when lecturing, and so because of CC instructors and leaners can access materials at all times and from any location, this eliminates the need to make copies, preventing the loss of assignments and materials (Sherdiwala, 2021). Students can learn on their own devices, at their own pace, and on their own time with applications that operate in the cloud, which require less hardware and work well in web browsers on both desktop and mobile devices (Kulkarni, 2021). Maximization of green potentials is another benefit of CC noted by Olaloye *et al.* (2019) due to the fact that CC saves datacentre processing power at the

client side and lowers carbon emissions, it gives institutions the capacity to cut their power consumption to the absolute minimum. Noor *et al.* (2017) listed scalability, service availability, security, flexibility, and sustainability as the benefits of CC. Studies also listed CC benefits that are directly realised by students and the faculty.

Benefits for Students:

- Al-Shqeerat *et al.* (2017) states that students now have new capabilities that were not adequately served by conventional methods thanks to cloud computing. With the cloud, students can electronically store everything, including their schedule, class notes, reports, and other documents (Al-Shqeerat *et al.*, 2017).
- CC gives students new abilities that are not adequately suited by conventional technologies. According to Rajesh (2017, p.3) "Nowadays, the students can store anything electronically such as their schedule, class notes, reports, and any other documents, and they able to back up their files to the cloud and retrieve them when needed".
- The issue of students' reluctance to purchase textbooks due to their expensive cost is resolved by giving students access to high-quality learning resources and e-copies of their textbooks for their classes (Al-Shqeerat *et al.*, 2017).
- To enrol in online classes, take online tests, and send projects and assignments to teachers via the cloud, students may simply log into the system at any time (Al-Shqeerat *et al.*, 2017).

Benefits for Faculty:

- Teachers now have a simple and adaptable platform to create their lectures, conferences, publications, and other course materials thanks to CC (Al-Shqeerat *et al.*, 2017).
- Teachers can design straightforward and adaptable course materials using cloud technologies, including presentations, conferences, papers, and more (Rajesh, 2017).
- Allowing instructors to do tasks like creating online tests, grading students, and scheduling classes while working from home and using their own devices (Al-Shqeerat *et al.*, 2017).
- Cloud offers academics a forum for discussion, access to vast computing capabilities, and adequate storage space (Rajesh, 2017).

All the above-mentioned benefits are useless if lecturers, students and all the users of CC in HEIs are unaware of their presence, importance and methods of application (Obiadazie & Okigbo, 2021). Consequently, to increase adoption and usage of CC in HEIs, decision makers must devise strategies and plans to increase the awareness of CC. Awareness education and training must be provided to all the users of CC in HEIs so that they can be knowledgeable and proficient in using the services of CC.

2.8 Impact of Covid-19 on Education

The epidemic is primarily a health problem, but it has had a significant impact on the education sector, with several countries deciding to close schools, colleges, and universities (Alhomdy *et al.*, 2021). HEIs have been closed as a result of the outbreak in 192 countries globally, with 91.4 percent of all enrolled students in those countries currently not being permitted to attend the institutions (Mahaye, 2020). On March 18, 2020, school closures in South Africa were announced, interfering with the education of over 2,3 million students enrolled in HEIs and roughly 17 million children in pre-school through secondary school (StatsSA, 2022). Landa, Zhou & Marongwe (2021) posited that some South African colleges were already having trouble starting the new academic year or making up for lost time owing to persistent student protests over a number of students demands when the president declared a lockdown. However, "disaster management now entailed that all schools and institutions of higher education were forced to close immediately for extended periods, necessitating alternative ways of ensuring access to education" (Landa *et al.*, 2021, p.167).

Online teaching and learning methods had to be used immediately away due to the sudden closure of schools and universities around the world, with a focus on maintaining a level of teaching and learning that satisfied the demands of both academic staff and students (Armoed, 2021). This pandemic "has forced everyone to adapt new methods of learning and teaching platforms, such as Zoom, Cisco WebEx, Microsoft Teams, and GoogleMeet continue to keep students connected" (Madhumitha *et al.*, 2021, p.85). Since Covid-19 first appeared, traditional teaching approaches were substituted with e-learning because social gatherings in higher education institutions are thought to be a source of the disease's spread (Maatuk, Elberkawi, Aljawarneh, Rashaideh & Alharbi, 2022). However, Kgari-Masondo & Chimbunde (2021, p.324) note that "the trenchant challenges posed by Covid-19 were exacerbated by the fact that the online teaching in African universities was still at the embryonic stage and most of them were caught unprepared". Despite the preceding claim, Chaka (2020) reports that, as part of their collaborative effort to maintain teaching and learning activities during Covid-19, 64 US institutions and 21 South African colleges made the move to online learning and used online tools and resources.

According to Mukhtar, Javed, Arooj & Sethi (2020) there are several identified benefits and drawbacks of e-learning. The advantages and disadvantages of e-learning are outlined in Table 2.4 of the study.

Table 2-3: Advantages and Disadvantages of E-learning

Source: (Mukhtar *et al.*, 2020, p.29)

Theme	Sub-Theme
Advantages	
Flexibility	Remote learning
	Easy administration
	Accessibility
Student-centered learning	Comfortable self-directed learning
	Asynchronous learning
Disadvantages	
Inefficiency	Skills teaching inability
	Lack of student feedback
	Lack of attentiveness
	Resource intensive
Maintaining academic integrity	Lack of discipline
	Plagiarism

Despite some challenges that e-learning presents to HEIs the advantages by far outweigh the disadvantages. With e-learning students are able to access their study material anywhere in the world all the time. It improves collaboration and communication between students to discuss different topics. During the Covid-19 pandemic the implementation of e-learning allowed universities to continue with classes in the form of distance learning. If e-learning were not available at the peak of the pandemic where face-to face learning was suspended to ensure social distancing classes would have been suspended until the pandemic ended or until a vaccine was found.

2.9 Accelerated Digital Transformation as a Result of Covid-19

Although the race to employ technology to improve learning has been ongoing for a while, the market for higher education has seen an explosion in automation and collaborative technology over the past 15 months (Renfrow, 2021). The COVID-19 pandemic has expedited this educational transformation and made some incredible new teaching strategies accessible for engaging students virtually (Renfrow, 2021). The pandemic "has affected the assessment of the use of ICT, but also the adoption of ICT in those segments where their potential has not yet been discovered in order to mitigate the social and economic effects of the spread of the virus" (Kutnjak, 2021, p.793)

Soto-Acosta (2020) noted retail, dining, and education are just a few examples of how Covid-19 has pushed the digitalization of businesses and entire sectors. Soto-Acosta (2020, p.261) stated that "Although electronic learning had been there before the pandemic, the COVID-19 pandemic accelerated and extended the digital transformation of traditional education organizations at all levels as the only possible way to continue their activities during the lockdown, but also in the new normal". According to Soto-Acosta (2020), before the pandemic, courses were either delivered online or in a

traditional classroom, but today HEIs are offering blended learning courses that include traditional face-to-face and online learning. As a result of the pandemic “digital technologies and platforms have provided and are still providing an emergency solution for making possible a form of schooling or education at a distance, in a situation where social distancing has become the basic norm” (Taglietti, Landri & Grimaldi, 2021, p.424). These technologies can serve as a lifeline in the areas of strategic decision-making, communication, information exchange, training, and business activity supervision, easing the strain the epidemic has placed on employers across a variety of industrial sectors (Kutnjak, 2021).

Krishnamurthy (2020) states that as a direct result of Covid's social distancing initiatives and to sustain service in emergency situations, institutions have undergone a significant shift to online education. Unprecedented difficulties were confronted by students who needed technical assistance, as well as by personnel and university administration, who had to swiftly reinvent themselves to maintain campus operations (García-Morales, Garrido-Moreno & Martín-Rojas, 2021). This transition from “in-person to virtual education will have significant implications for the entire learning process, not only extensively modifying methods for assessing learning outcomes but also requiring reconsideration of the skills and competencies required of students in this new setting” (García-Morales *et al.*, 2021, p.2). The majority of HEIs are aware that this technology revolution in education requires considerable adjustments to core skills, evaluation techniques, and pedagogical approaches (García-Morales *et al.*, 2021).

2.10 Theoretical Framework

2.10.1 Technology Adoption Theories

According to Venkatesh *et al.* (2003), in the topic of individual acceptance, there are eight models and theories to consider. These theories and models are as follows:

Table 2-4: Technology Adoption Theoretical Framework

Author	Framework
Fishbein & Ajzen (1977)	Theory of Reasoned Action (TRA)
Davis (1989)	Technology Acceptance Model (TAM)
Davis *et al.* (1992)	Motivational Model (MM)
Ajzen (1991)	Theory of Planned Behaviour (TPB)
Taylor & Todd (1995)	Combined TAM and TPB
Thompson *et al.* (1991)	Model of PC Utilization (MPCU)
Moore & Benbasat (1991)	Innovation Diffusion Theory (IDT)
Compeau *et al.* (1999)	Social Cognitive Theory (SCT)

According to Abbad (2021) there have been five primary models of technology adoption suggested so far, namely Theory of Reasoned Action, Technology Acceptance Model, Technology Acceptance Model 2, Innovation Diffusion Theory and Unified Theory of Acceptance and Use of Technology.

2.10.1.1 Theory of Reason Action

The Theory of Reasoned Action (TRA) is one of the most fundamental and prominent theories of human behaviour, having been developed by (Fishbein & Ajzen, 1977). It has been used to forecast a variety of behaviours. According to the TRA, one's behaviour intention is the strongest or most proximal predictor of volitional behaviour (Hale, Householder & Greene, 2002).

Attitude: An attitude, as it relates to the TRA, " is an affective or valanced response toward performing some behaviour and not toward some generalised attitude object" (Hale *et al.*, 2002, p.260).

Subjective norm: Is a "person's belief about whether significant others feel that he / she should perform the targeted behaviour" (Hale *et al.*, 2002, p.260)

2.10.1.2 Technology Acceptance Model

Fred Davis proposed the Technology Acceptance Model (TAM) for his doctoral dissertation in 1986 (Lai, 2017). TAM is the most prevalent technology acceptance model that previous academics have looked at (Al-Mamary, Al-nashmi, Hassan & Shamsuddin, 2016). The two most crucial components of TAM are perceived usefulness and ease of use (Al-Mamary *et al.*, 2016).

Perceived Ease OF Use (PEOU): Is "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989, p.320)

Perceived Usefulness (PU): Is "the degree to which a person believes that using a particular system would enhance his or her job performance" as defined by (Davis, 1989, p.320)

2.10.1.3 Technology Acceptance Model 2

Venkatesh & Davis (2000) established Technology Acceptance Model 2 (TAM2) in the year 2000, based on TAM. Venkatesh & Davis (2000) recognized that TAM had certain limitations in describing why someone could find a system beneficial, thus they suggested that additional variables be added as antecedents to the perceived usefulness variable in TAM. TAM2's purpose is to extend TAM to incorporate new major determinants of TAM's perceived usefulness and use intent components, as well as to understand how these determinants' effects alter with increased user experience with the target system over time (Venkatesh & Davis, 2000). Using TAM as the starting point, "TAM2 incorporates additional theoretical constructs spanning social influence processes (subjective norm, voluntariness, and image) and cognitive instrumental processes (job relevance, output quality, result demonstrability, and perceived ease of use)" (Venkatesh & Davis, 2000, p.187).

Subjective norm: is defined as a "person's perception that most people who are important to him think he should or should not perform the behaviour in question" (Fishbein & Ajzen, 1977, p.320)

2.10.1.4 Diffusion of Innovation

The notion of innovation adoption and diffusion is a valuable systematic paradigm for describing new technology acceptance or non-adoption (Al-Mamary *et al.*, 2016). Diffusion happens gradually within one market when knowledge and views about a new technology are spread among potential customers via communication channels (a system of users) (Al-Mamary *et al.*, 2016). As defined by Al-Mamary *et al.* (2016, p.153) "diffusion of innovations is a theory that seeks to explain how, why, and at what rate new ideas and technology spread through cultures". The best framework for examining how technology is being adopted in higher education and educational settings is Rogers' diffusion of innovations theory (Sahin, 2006). According to Rogers (2003), perceptions of an innovation's attributes play a significant role in determining how quickly it is adopted. These attributes are relative advantage, compatibility, complexity, trialability and observability (Rogers, 2003).

Relative Advantage: is a measurement of how much the invention is thought to be an enhancement over the original concept (Rogers, 2003). The components of relative advantage include the incentive of cost and social status that drive innovation (Sahin, 2006).

Compatibility: relates to the question of whether a technological advancement is consistent with current principles, values, and knowledge (Rogers, 2003).

Complexity: is to how easily a new invention can be used and understood (Rogers, 2003). Contrary to the other characteristics, complexity is negatively correlated with the adoption rate, rendering excessive complexity of an innovation a substantial obstacle to adoption (Sahin, 2006).

Trialability: is "the degree to which an innovation may be experimented with on a limited basis" (Rogers, 2003, p.16). Trialability and adoption rates have a positive relationship, therefore the more an invention is tested, the more quickly it is accepted (Sahin, 2006).

Observability: is "the degree to which the results of an innovation are visible to others" (Rogers, 2003, p.16).

2.10.1.5 *Unified Theory of Acceptance and Use of Technology*

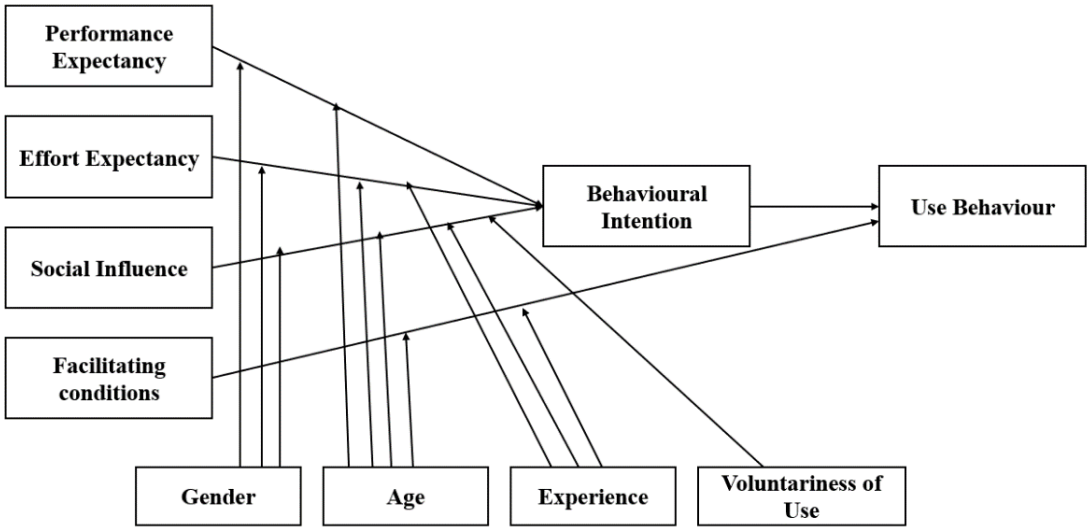
UTAUT "is a combination of eight other models, which are: Theory of Reasoned Action (Fishbein & Ajzen, 1977), Technology Acceptance Model (Davis, 1989), Motivational Model (Davis, Bagozzi & Warshaw, 1992), Theory of Planned Behaviour (Ajzen, 1991), Combined TAM and TPB (Taylor & Todd, 1995), Model of PC Utilization (MPCU) (Thompson, Higgins & Howell, 1991), Innovation Diffusion Theory (Moore & Benbasat, 1991), and Social Cognitive Theory (Compeau, Higgins & Huff, 1999)" (Abu, Jabar & Yunus, 2015, p.105). Ammenwerth (2019) states that the UTAUT model was created and developed by Venkatesh *et al.* (2003) where they identified four main constructs for the model, namely (1) performance expectancy, (2) effort expectancy, (3) social influence, and (4) facilitating conditions influencing behavioural intentions and usage behaviour. This model, which incorporates the following elements, is used in this study (Venkatesh *et al.*, 2003, p.447-453):

- *Performance Expectancy (PE):* Is "the degree to which an individual believes that using the system will help him or her to attain gains in job performance".
- *Social Influence (SI*): Is "the degree to which an individual perceives that important others believe he or she should use the new system".
- *Effort Expectancy (EE):* Is "the degree of ease associated with the use of the system".
- *Facilitating Conditions (FC):* Is "the degree to which an individual believes that an organisational and technical infrastructure exists to support the use of the system".

This study aims to utilize the UTAUT model to understand the role of CC in HEIs during the pandemic. This model describes users' intentions to use new technologies as well as their actual usage patterns (Amron, Ibrahim, Bakar & Chuprat, 2019). Furthermore, Amron *et al.* (2019, p.3) highlighted that "the strength of UTAUT framework lies in the fact that it was founded on so many models and thus providing the researcher with a broader view of all existing models". UTAUT can help in determining a variety of factors that impact the acceptance of information systems (Chao, 2019). The UTAUT model was used by Venkatesh *et al.* (2003) to describe human acceptance behaviour in a number of contexts. UTAUT was utilized by Chao (2019) to assess the behavioural intent to employ mobile learning. In order to understand how students in underdeveloped countries use e-learning platforms Amron *et al.* (2019) employed UTAUT to evaluate the uptake of CC in the Malaysian public sector. Both Abbad (2021) and Sokhulu (2021) used the UTAUT model to analyse learners experience using online tools to meet their individual research needs during the Covid-19 lockdown.

Figure 2-4: UTAUT Model

Source: (Venkatesh *et al.*, 2003)



2.11 Chapter Summary

The main aim of this chapter is reviewing existing CC adoption in HEIs literature, and the main focus was on developing countries seeing that South Africa is a developing country, as well and this study was undertaken is South Africa. This chapter first started by discussing CC overview which included cloud service models, cloud deployment models and cloud essential characteristics. The chapter further discussed cloud adoption in developing countries, factors influencing cloud adoption and cloud in HEIs. Additionally, challenges and benefits of CC in education were discussed as well. The research approach taken for this study will be covered in the following chapter.

3 CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

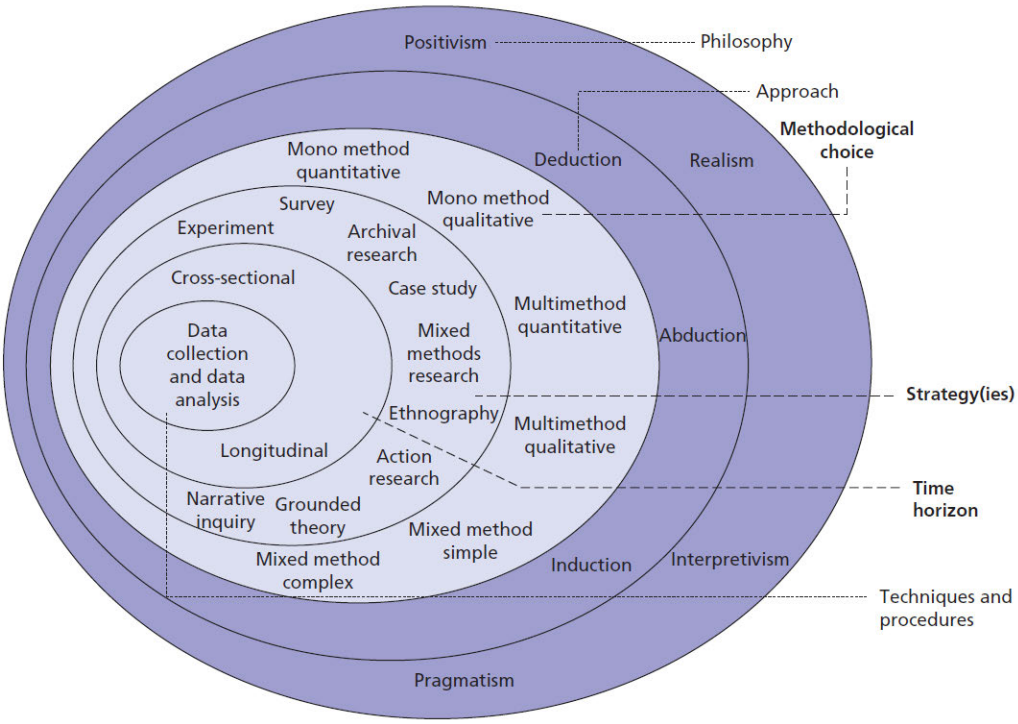
The chapter preceding covered the literature review for this particular study. This chapter examines the approaches taken to address the research questions and accomplish the objectives of the study in order to comprehend the factors impacting the adoption of CC in HEIs during COVID-19: a case study of UKZN. All of the sections that make up research methodology are covered in chapter 3.

3.2 Research Design

A project's research design serves as a blueprint for the intended study effort and can be thought of as the thread that connects all of its constituent parts (Akhtar, 2016). It includes explicit objectives derived from your research question(s), a list of the data sources you want to use, a description of the data collection and analysis process, discussion of ethical issues, and a list of the limits you will inescapably encounter (Saunders, Lewis & Thornhill, 2009). According to Akhtar (2016), the types of research design that exist are descriptive, exploratory, explanatory, and experimental. An exploratory research design is used to produce a preliminary idea for a study when there is no prior understanding of a topic (Kothari, 2004). Such studies' primary goals are to formulate a topic for more in-depth examination or to generate the working hypotheses from an operational standpoint (Kothari, 2004). On the other hand "Explanatory design, seeks explanations of observed phenomena, problems, or behaviours" (Bhattacherjee, 2012, p.6). To forecast organizational outcomes or to explain the variance in the dependent variable, hypothesis testing is done (Sekaran & Bougie, 2016). This nature of this study is descriptive. A descriptive study is "undertaken in order to ascertain and be able to describe the characteristics of the variables of interest in a situation" (Sekaran & Bougie, 2016, p.121). To conduct this study a framework called "research onion" by Saunders, Lewis & Thronhill (2012) was implemented and followed.

Figure 3-1: Research Onion Framework

Source: (Saunders *et al.*, 2012, p.128)



3.3 Research Philosophy

The research philosophy serves as the initial layer of the research onion framework. Saunders, Bristow, Lewis & Thornhill (2015, p.130) defined "research philosophy as a system of beliefs and assumptions about the development of knowledge". A research philosophy is a manner of approaching the collection, interpretation, and analysis of data (Zefeiti & Mohamad, 2015). The researcher uses this layer to represent significant assumptions about his or her opinions and how they relate to how the world operates in a given study (Zefeiti & Mohamad, 2015). These presumptions ultimately influence how you formulate your research questions, choose your methodology, and analyse your results (Saunders, Lewis & Thronhill, 2019). A credible research philosophy will be supported by a well-considered and coherent set of assumptions, which will guide your methodological decision, research plan, data gathering methods, and analytic procedures (Saunders *et al.*, 2019). According Saunders *et al.* (2015) Positivism , Realism, Interpretivism and Pragmatism are the four philosophies of the research onion framework. For this study, the positivism philosophy was adopted and used.

3.3.1 Realism

The fundamental tenet of realism is that what we perceive is reality: that things exist independently of human thought (Saunders *et al.*, 2012). Realists contend that despite the researcher's own experiences and worldviews, reality is independent of the mind and what their senses tell them is the true world

(Saunders & Tosey, 2013). Both realism and positivism are epistemological schools that approach knowledge growth scientifically (Saunders *et al.,* 2012).

There are two kinds of realism the first one being critical realism and the other is direct realism. What we perceive through our senses accurately represents the reality, according to direct realism (also known as naive empirical scientific realism) (Saunders *et al.*, 2015). A researcher who takes a direct realist stance claims that what we perceive with our senses accurately represents reality (Saunders *et al.*, 2015)

According to critical realists, we truly perceive sensations or mental representations of actual objects rather than directly experiencing them as physical objects (Saunders *et al.,* 2015). According to the critical realism perspective, what is initially perceived through the senses is later processed subjectively by the mind. Critical realism seeks to explain what we see and feel in terms of the fundamental truths that underlie the apparent events (Saunders *et al.*, 2015).

3.3.2 Pragmatism

Pragmatism asserts that "concepts are only relevant where they support action" (Saunders *et al.*, 2012, p.130). According to Saunders *et al.* (2019, p.151) "pragmatism aims to balance subjectivism with objectivism, values and knowledge, precise and rigorous information, and many contextualized experiences". This is accomplished through considering theories, concepts, ideas, hypotheses, and research findings with regard to how they operate as instruments for thought and action as well as the implications they have for practical applications in a variety of contexts (Saunders *et al.*, 2019).

3.3.3 Interpretivism

"Interpretivism emphasises that "humans are different from physical phenomena because they create meanings" (Saunders *et al.*, 2015, p.148). Contrary to positivism, which seeks to give clear, general laws that can be applied to everyone independent of some key elements and conditions, interpretivism seeks to incorporate richness in the learned insights (Alharahsheh & Pius, 2020).

3.3.4 Positivism

"Positivism relates to "the philosophical stance of the natural scientist and entails working with an observable social reality to produce law-like generalisations" (Saunders *et al.*, 2019, p.144). The positivist viewpoint is founded entirely on the idea that scientific knowledge is valid knowledge of the world and that scientific knowledge is true and demonstrated by research questions (hypotheses) derived from accepted theories (Saunders *et al.*, 2012). Alharahsheh & Pius (2020) claimed that positivism is strictly focused on weighing data and facts without being influenced by human interpretation or bias, emphasizing the relevance of what is offered in general. This study used the positivism paradigm to understand the factors influencing the adoption of CC at UKZN.

3.4 Research Approach

The deductive and inductive approaches are the two primary research philosophies that the research onion highlights. The deductive approach involves “the development of a theory that is then subjected to a rigorous test through a series of propositions” (Saunders *et al.*, 2019, p.153). When you design a research plan to test a hypothesis that is typically developed via your reading of academic literature, you are using a deductive technique (Saunders *et al.*, 2012).

When utilizing inductive reasoning, the conclusion is "judged" to be backed by the interpretations made, however there is a logical gap between the premises observed and the conclusion (Saunders *et al.*, 2012). In induction, we use observed data to demonstrate a general proposition logically (Sekaran & Bougie, 2016). When conducting research using the inductive method, you first collect data to examine a phenomenon before developing or constructing theory, typically in the form of a conceptual framework (Saunders *et al.*, 2012). This study follows the deductive research approach to answer the questions and achieve the objectives that were created from the constructs of the UTAUT model.

3.5 Research Method

The third layer of the research onion is called the methodological choice. The three methodological choices a researcher can choose to adopt for their respective study are quantitative, qualitative and mixed methods (Saunders *et al.*, 2012). Various factors, including study questions, aims, and topic, determine which research method is most appropriate (Zefeiti & Mohamad, 2015). Researchers can opt to utilize a single technique of data collection and the accompanying analysis procedure, such as a single method qualitative design (for example, data collected through in-depth interviews, narratively analysed) or a single method quantitative design (for example, data obtained using a questionnaire and statistically analysed) (Saunders & Tosey, 2013). In multimethod quantitative designs, the researcher makes use of a variety of statistical techniques for collecting quantitative data (for instance, a questionnaire and structured observation) (Saunders & Tosey, 2013).

3.5.1 Quantitative Method

The study used a questionnaire survey to conduct a quantitative analysis of the variables influencing the adoption of CC at HEIs. The foundation of quantitative research is the measurement of quantity or amount, and it applies to phenomena that can be described in terms of quantity (Kothari, 2004). This approach is used “to quantify attitudes, opinions, behaviours and other defined variables, and generalize results from a larger sample population” (Wyse, 2011, p. 1). Quantitative research is “a means for testing objective theories by examining the relationship among variables. These variables, in turn, can be measured, typically on instruments, so that numbered data can be analysed using statistical procedures” (Creswell, 2009, p.22).

3.5.2 Qualitative Method

Comparatively, qualitative research focuses on qualitative phenomena, such as when we want to learn more about the causes of human behaviour (Kothari, 2004). It entails looking into and understanding the interpretations that people make on social or human situations (Creswell, 2009).

3.5.3 Mixed Method

Mixed techniques research "is a type of inquiry that associates or combines qualitative and quantitative methods of inquiry; it involves philosophical presumptions, the use of both qualitative and quantitative procedures, and the blending of the two approaches in a study" (Creswell, 2009, p.104).

3.6 Research Strategy

A plan for how a researcher will approach solving a research problem may be seen as a research strategy since a strategy is, generally speaking, an action plan to achieve a goal (Saunders *et al.*, 2012). According to Saunders *et al.* (2019, p.189) "particular research strategies may be associated with a particular research philosophy and also a deductive, inductive or abductive approach". Your research question(s) and objectives, their congruence with your philosophy, research approach, and purpose, as well as more pragmatic factors like the size of your study's field, the amount of time and other resources you have at your disposal, and your access to potential participants and other data sources, all have an impact on the research strategy you choose (Saunders *et al.*, 2012). The "research methodologies employed with either the quantitative, qualitative, or mixed approaches include experiments, surveys, archival research, case studies, ethnographies, action research, grounded theory, and narrative inquiry" (Saunders *et al.*, 2012, p.173)

3.7 Time Horizon

This layer specifies the timeline for the study, which can be cross-sectional, short-term (data collecting occurs at a specific moment), or longitudinal (data collection occurs over a lengthy period of time in order to compare results) (Melnikovas, 2018).

3.7.1 Cross sectional

One-shot or cross-sectional studies are ones in which information is only gathered once to answer a research topic, maybe over a period of days, weeks, or months (Sekaran & Bougie, 2016). According to Sahay (2016, p.4) "where a problem at a particular time is to be dealt with, a cross-sectional research is undertaken to answer a question or solve the problem". The cross-sectional time horizon is used in this study since the university stipulates that the study must be finished within a specific time frame.

3.7.2 Longitudinal

To fully address the research subject, the researcher may in some instances wish to examine individuals or events at various points in time question (Sekaran & Bougie, 2016). The ability of longitudinal research to investigate change and development is its main strength, and it may also provide you some degree of control over some of the factors being researched (Saunders *et al.*, 2019).

3.8 Study Site

Study site refers to the site or locations under the institution's control where the Study is actually carried out (Law-Insider, 2022). The study setting is “a critical component of a research study as the nature, context, environment, and logistics of the study setting may influence how the research study is carried out” (Majid, 2018, p.3). UKZN PMB campus is where this study was carried out. UKZN has five campuses in total which are Edgewood, Howard, Pietermaritzburg, Medical School, and Westville. Due to the researcher's convenience in gathering information for the aforementioned study, the investigation was conducted on the PMB campus.

3.9 Technique and Procedures

The last layer of the research onion, sometimes referred to as the core of the research onion, is made up of techniques and processes. It is concerned with describing in detail the procedures to be followed for data gathering and analysis.

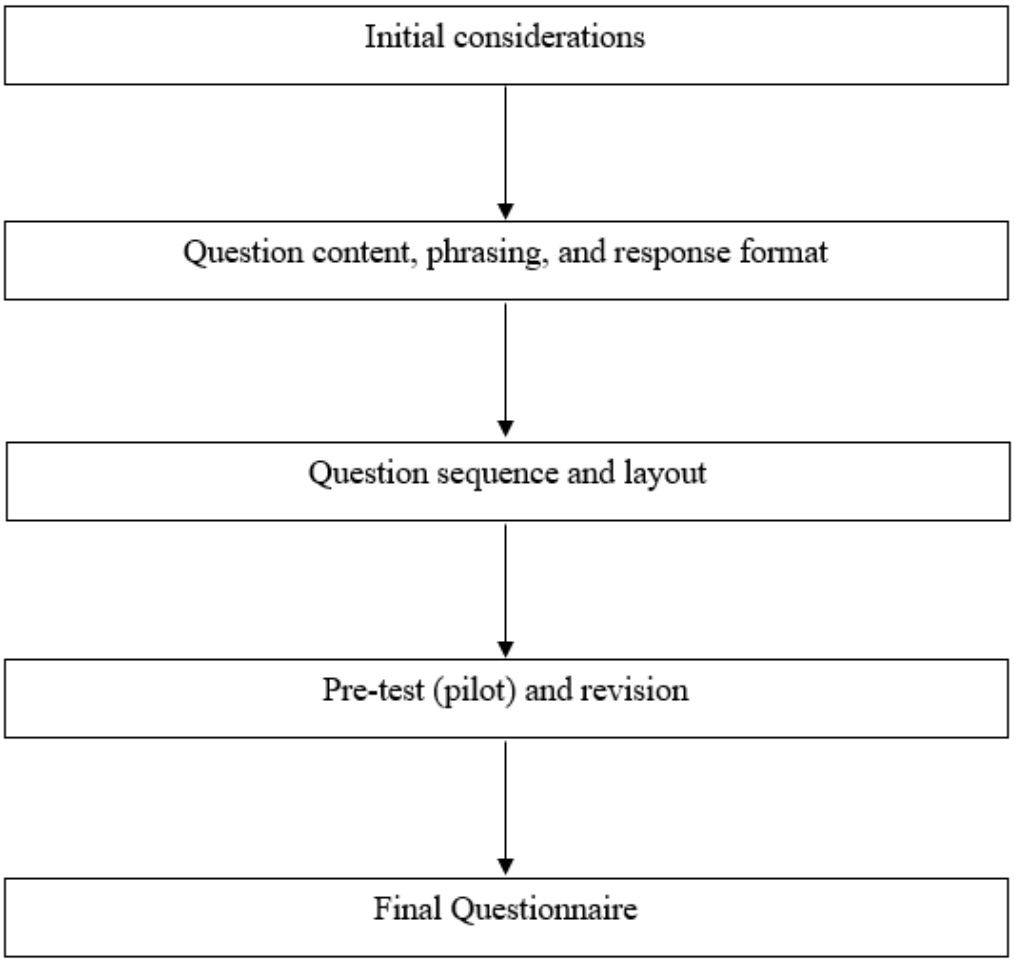
3.9.1 Questionnaire Design and Development

The questionnaire was developed in the late 1800s by Sir Francis Galton, a British anthropologist, adventurer, and statistician (Roopa & Rani, 2012). Malhotra (2006, p.176) stated that “a questionnaire is a formalized set of questions for obtaining information from respondents”. The primary goal of the questionnaire is to convert the researcher's information needs into a series of focused inquiries that respondents are eager and prepared to answer (Malhotra, 2006). Another importance of the questionnaire is that it “enables quantitative data to be collected in a standardized way so that the data are internally consistent and coherent for analysis” (Malhotra, 2006, p.176).

Any research study must carefully craft its questionnaire because a poor questionnaire design might mislead research, academia, and policymaking (Acharya, 2010). A questionnaire must therefore have a number of appropriate and pertinent questions in a logical order (Acharya, 2010). The two primary types of questionnaires are structured and unstructured (Acharya, 2010). Additionally, there is the quasi-structured questionnaire, which combines these two and is frequently used in social science research (Acharya, 2010). This study used a close-ended also known as structured research tool to collect information about the factors that influence the adoption of CC in HEIs. The questionnaire utilised a series of questions from previous studies, which used the UTAUT model to assess factors influencing the adoption of CC. A well-designed questionnaire demands consideration and work, and it must be prepared and developed in the following stages (Roopa & Rani, 2012).

Figure 3-2: Stages of Planning a Questionnaire

Source: (Roopa & Rani, 2012, p.273)



The questionnaire which was used for this study is located in appendix B and it is arranged as stated below:

SECTION A

This is the first portion of the questionnaire, and its primary goal is to gather participants' demographic data. The section started from question one and ended at question four. This sections asked for participants to provide their age, gender, degree they are registered for and their respective college of study.

SECTION B

This section is about discovering the participants usage of CC for learning purposes. This section is from question 5 to question 7, where participants were asked to about their usage of CC, the CC services they use and the devices they use to access CC services.

SECTION C

This section's main purpose was to investigate the factors thar influence the adoption of CC for students at the UKZN PMB campus. A five-point Likert scale was utilized for the questions, with the options being Strongly agree=1, Agree=2, Neutral=3, Disagree=4 and Strongly disagree=5. The questions were based on the UTAUT constructs which is the framework that is being used for this study.

SECTION D

This is the concluding portion of the survey which is also assessing UTAUT constructs. The aim of this session is to identify the intention to adopt CC and the use behaviour of cloud computing. A five-point Likert scale ranging from Strongly agree=1, Agree=2, Neutral=3, Disagree=4 and Strongly disagree=5 was also used for this section.

3.9.2 Pilot Test

To test various elements of the procedures intended for a larger, more in-depth, or confirmatory research, a small feasibility study known as a "pilot study" is used (Lowe, 2019). Pilot testing "is the most appropriate tool and play indispensable role while conducting large scale survey to increase the reliability, validity and practicability of the questionnaire, especially in management, social sciences and education studies" (Wadood, Akbar & Ullah, 2021, p.2419). A pilot test for the current study was conducted from 11 participants of the study's sample. Based on the respondents' answers and suggestions the questionnaire was then updated accordingly. Furthermore, the questionnaire was sent to a PhD candidate who provides research services for further analysis, alignment, and corrections. Suggestions made by the PhD candidate were taken into consideration and executed by the researcher. For example, there is a section that was removed, some questions wording was updated as well. Any grammar and spelling errors were corrected.

3.10 Target Population

It should be noted that the term "population" describes the full set of observations that can be made on a collection of individuals, events, or objects of interest, allowing the researcher to reach conclusions (Pandey & Pandey, 2021). The whole student body of the UKZN PMB campus was included in this study. Thacker (2020) states that the target population should be readily and easily accessible to successfully conduct a study. At the Pietermaritzburg campus, there are currently 8788 enrolled students (Reports, 2022). De Morgan's sampling table was used to choose the study's sample. According to Krejcie & Morgan (1970), the sample size should be about 368 if the population is 8788.

Table 3-1: Krejcie and Morgan Table

Source: (Krejcie & Morgan, 1970)

N	*S*	*N*	*S*	*N*	*S*
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	1000000	384

Note.—*N* is population size. *S* is sample size.

3.11 Sampling Strategy

Choosing a statistically representative sample of people from the target group is called the process of sampling (Majid, 2018). In the same vein, Sekaran & Bougie (2016) defines sampling as the process of selecting the right individuals, objects, or events for study. Sampling is a crucial tool for research projects since the target population typically comprises of too many people for any research study to involve as participants (Majid, 2018). Majid (2018) further states that a good sample is one that statistically represents the intended audience and is substantial enough to address the research question.

In general, there are two types of sampling methods: probability samples and non-probability samples (Bhattacherjee, 2012). Non-probability samples "are those in which the probability that a subject is selected is unknown and results in selection bias in the study" (Acharya, Prakash, Saxena & Nigam, 2013, p.332). According to Acharya *et al.* (2013) probability sampling is considered the preferred sampling method for ensuring the generalizability of study findings to the target population, and is often

regarded as the gold standard in sampling techniques. By probability sampling we mean, "each individual in the population has an equal chance of being selected in the study" (Acharya *et al.*, 2013, p.330). The fact that students are currently spread out across different regions makes it difficult to employ the probability sampling technique for the current research. Consequently, a non-probability sampling strategy was adopted in this investigation, called the convenience sampling approach. This is the most popular sampling approach; respondents are typically chosen because they are present at the right time and place, which is convenient for the investigator (Acharya *et al.*, 2013).

3.12 Data Analysis

The Statistical Package for Social Science (SPSS v28) and the SMARTPLS (V4.0) were used to analyse the information gathered from the questionnaires filled in by the respondents. A quantitative questionnaire was administered to the sample population chosen to partake in the study. The analysis began by doing a reliability and validity test. The Cronbach's alpha coefficient was used to measure the internal consistency of the model's constructs. To evaluate validity the Heterotrait-Monotrait (HTMT) ratio, together with composite reliability and average variance extracted was used. Following this the researcher then went on to analyse the descriptive statistics. To assess the normality of the data in order to determine the distribution of the data the Kolmogorov-Smirnov and Shapiro-Wilk normality tests were utilised. The Spearman's RHO correlation, a non-parametric test, was used because the study's data did not follow a normal distribution.

Table 3-2: Data Analysis Methods

Objective	Data Analysis Method
Descriptive Statistics	Frequency, Cumulative Frequency, Percentage, Cumulative Percentage
Normality Test	Kolmogorov-Smirnov and Shapiro-Wilk
Reliability Test	Cronbach's Alpha
Validity Test	PLS-SEM, Composite Reliability, Average Variance Extracted, Heterotrait-Monotrait (HTMT) ratio
Construct Correlation	Spearman's Rho Correlation

3.13 Ethical Consideration

The study of moral behaviour, integrity, and motivations is called ethics, its focus is on establishing what is beneficial or desirable to everyone (Rani & Sharma, 2012). To safeguard the rights and dignity of study participants, ethical considerations are crucial (Hasan, Rana, Chowdhury, Dola & Rony, 2021). The questionnaire included a consent letter for participants to sign granting the researcher rights to utilise the responses to the questionnaire.

Ethical clearance was applied for and approved by the UKZN Humanities and Social Science Research Ethics Committee (HSSREC) the letter is attached on the appendix. Additionally, a gatekeeper's letter was obtained also from UKZN prior to conducting the research. The participant's information was kept confidentially as the dissertation did not include any of the individuals' personally identifiable information.

3.14 Chapter Summary

This chapter provided a description of the research methodology used in this study. More information about the plan for conducting the study utilizing the research onion framework was provided. The research onion has six layers which are research philosophy, research approach, research strategy, research method, time horizon and techniques & procedures which were all discussed in this chapter. In addition, the data analysis section was discussed highlighting the tests that were utilised in this research. To conclude target population, sampling strategy and ethical considerations were also covered in this chapter.

4 CHAPTER FOUR: DATA ANALYSIS

4.1 Introduction

In this chapter, research results gathered from the participants of this study which are students at UKZN, PMB campus and presented and discussed. A questionnaire was both physically handed out and placed online for the participants to respond. This chapter firstly discusses the response rate and the reliability of the instrument used to collect data. It further discusses the normality tests performed and descriptive analysis on the collected data.

4.2 Response Rate

The intended sample population of this study was 370. After the questionnaire was administered only 330 participants responded to the survey, which constitutes 89% of the total sample population. This percentage is deemed adequate, because it exceeds the minimum response rate of 60% needed for a reliable data analysis (Sekaran & Bougie, 2016).

4.3 Reliability Analysis Test

The reliability of the questionnaire, specifically its capacity to yield consistent results at many times and under various conditions, determines the strength of the questionnaire (Saunders *et al.*, 2012). Although there are various techniques to assess reliability, Cronbach's alpha is one of the most widely used metrics (Saunders *et al.*, 2012). By definition, "Cronbach's alpha is a reliability coefficient that indicates how well the items in a set are positively correlated to one another" (Sekaran & Bougie, 2016, p.307). It is made up of an alpha coefficient with a value ranging from 0 to 1, values of 0.7 or higher show higher consistency (Saunders *et al.*, 2012). In this study, the researcher discovered that, with the exception of the final construct, use behaviour, which could not be examined for reliability because it only contains one statement, the observed values of Cronbach's alpha for the five other constructs measured ranged between 0.822 and 0.962. All of the observed values are greater than 0.7, which is excellent because it indicates a high level of reliability and high correlation between the variables. The output of the computations is displayed in Table 4.1 below.

Table 4-1: Cronbach's Alpha Coefficient Values

Construct	No of Likert Scale Items	Cronbach's Alpha	Comments
Performance Expectancy	4 (PE1 to PE4)	0.874	High Reliability
Effort Expectancy	4 (EE1 to EE4)	0.951	High Reliability
Facilitating Conditions	4 (FC1 to FC4)	0.822	High Reliability
Social Influence	4 (SI1 to SI4)	0.890	High Reliability
Behavioural Intention	3 (BI1 to BI3)	0.962	High Reliability
Use Behaviour	1 (UB1)	-	Cannot be tested

4.4 Validity Analysis Test

Validity refers "to whether the measuring instrument measures the behaviour or quality it is intended to measure and is a measure of how well the measuring instrument performs its function" (Sürücü & Maslakçi, 2020, p.2696). Specifically, validity is concerned with whether we are measuring the correct things or not. The goodness of measures are tested using a variety of validity tests, each of which is referred to by a different word in the literature (Bajpai & Bajpai, 2014). The three main categories of validity are content validity, criterion related validity and construct validity. For this study only the content and construct validity categories are applicable.

Content validity is defined as "the degree to which items in an instrument reflect the content universe to which the instrument will be generalized" (Taherdoost, 2016, p.30). In general, determining a new survey instrument's content validity entails determining if it includes all necessary items and leaves out any that are irrelevant to a certain idea area (Taherdoost, 2016). For this study, the questions on the research instrument were constructed and structured so that they achieved the objectives of the study. The link from the research instrument to the objectives ensures content validity.

Bajpai & Bajpai (2014, p.113) stated that "Construct validity testifies to how well the results obtained from the use of the measure fit the theories around which the test is designed". Construct validity, in other words, is the capacity to draw test findings from the topic of the study from test outcomes (Heale & Twycross, 2015). Alshamaila (2013) claimed that convergent validity and discriminant validity are two subcategories of concept validity. For construct validity to be confirmed both the convergent and discriminant validity need to be evaluated.

4.4.1 Convergent Validity

Convergent validity "is established when the scores obtained with two different instruments measuring the same concept are highly correlated" (Sekaran & Bougie, 2016, p.207). PLS-SEM uses three measures, namely Cronbach's Alpha coefficient, Composite Reliability, and Average Variance Extracted, to evaluate convergent validity.

4.4.1.1 Cronbach's Alpha

The Cronbach alpha coefficient is a statistic that is frequently employed to analyse the consistency of answers to a set of questions that are combined to form a scale to rate a certain subject (Saunders *et al.*, 2012). A reliability number greater than 0.7 typically denotes an appropriate statistical testing level when using the Cronbach's Alpha technique (Al-Zefeiti & Mohammad, 2015).

4.4.1.2 Composite Reliability

As defined by Werts et al. in 1978, "Composite Reliability" is the consistency of a measurement instrument's connection between observable variables and latent variables (Sürücü & Maslakçi, 2020). To measure construct validity the obtained composite reliability values must be greater than 0.7 (Alshehri, 2012).

4.4.1.3 Average Variance Extracted

Average Variance Extracted calculates the variance for each construct and displays the total variance for each construct as a ratio (Gefen, Straub & Boudreau, 2000). To obtain convergent validity, each average variance extracted value must be greater than 0.5 and the AVE values must be lower than the composite reliability (Sürücü & Maslakçi, 2020).

The table below visually represents values that are used to measure convergent reliability, which are the Cronbach's alpha, Composite Reliability and Average Variance Extracted. Table 4.2 shows that all the values for composite reliability exceeded the stated criteria of 0.7, while the Average Variance Extracted was above the required 0.6 for all the values and the Cronbach's alpha coefficient for all the constructs was also greater than the required value of 0.7. Since the items of the questionnaire (constructs of UTAUT) for the current study are all at acceptable levels, convergent validity is has passed and is accepted.

Table 4-2: Convergent Validity

	Cronbach's Alpha	Composite Reliability (CR)	Average Variance Extracted (AVE)
Performance Expectancy	0.876	0.917	0.736
Effort Expectancy	0.952	0.965	0.874
Facilitating Conditions	0.831	0.888	0.666
Social Influence	0.889	0.924	0.754
Behavioural Intention	0.962	0.975	0.929

4.4.2 Discriminant Validity

"Discriminant validity "is proved when two variables are theoretically predicted to be uncorrelated and the scores obtained by measuring them are in fact empirically determined to be uncorrelated" (Sekaran & Bougie, 2016, p.207). When expressions on the scale are more closely associated to one particular factor than to the others, this is referred to as discriminant validity; in other words, one item is related to one component (Sürücü & Maslakçi, 2020). Hair, Henseler, Dijkstra & Sarstedt (2014) stated that The Heterotrait-Monotrait Ratio (HTMT) is the most effective method for establishing discriminant validity. Questionable conclusions emerge from a model's lack of discriminant validity, casting doubt on whether the data actually support the results (Rasoolimanesh, 2022). The Fornell-Larcker criterion, cross-loadings, the Heterotrait-Monotrait (HTMT) ratio, and full collinearity assessment were among the techniques previously presented to test discriminant validity using PLS-SEM Fornell & Larcker (1981); Henseler, Ringle & Sarstedt (2015); Rasoolimanesh, Nejati, Lei Mee, Ramayah, Shafaei & Abd Razak (2017). For the purposes of this study the Heterotrait-Monotrait (HTMT) ratio was used to assess the discriminant validity of the constructs. The Heterotrait-Monotrait (HTMT) ratio "is defined as the mean value of the indicator correlations across constructs" (Hair Jr, Hult, Ringle, Sarstedt, Danks & Ray, 2021, P.80). There is disagreement about the exact HTMT threshold level; some authors such as (Kline, 2015; Clark & Watson, 2016) advocate a value of 0.85 while others Gold, Malhotra & Segars (2001); Teo, Srivastava & Jiang (2008) advocate 0.90. However, Henseler *et al.* (2015) argued that for PLS-SEM the HTMT ration value should be less than 1.0. Table 4.3 below represents the results of the discriminant validity. In the table all the constructs are less than 1.0, therefore the discriminant validity for all the constructs of UTAUT used in study is established.

Table 4-3: Discriminant Validity

	Behavioural Intention	Effort Expectancy	Facilitating Conditions	Performance Expectancy	Social Influence	Use Behaviour
Behavioural Intention						
Effort Expectancy	0.711					
Facilitating Conditions	0.803	0.879				
Performance Expectancy	0.773	0.804	0.868			
Social Influence	0.665	0.630	0.808	0.729		
Use Behaviour	0.670	0.619	0.707	0.697	0.617	

4.5 Descriptive Analysis

4.5.1 Participants Age

At the beginning of the questionnaire participants were asked to select their ages from the brackets of ages provided. The results show that most participants range between 17-24, which constituted 52.7% (n=174) followed by participants between the ages of 25-30 with a total of (n=125) 37.9%. The last two brackets have the lowest number of respondents with the bracket of 30-35 having a percentage of 8.5% (n=28). The least number of participants came from the 35+ age range has a percentage of 0.9% (n=3). Table 4.4 below presents the data collected for the participants age groups.

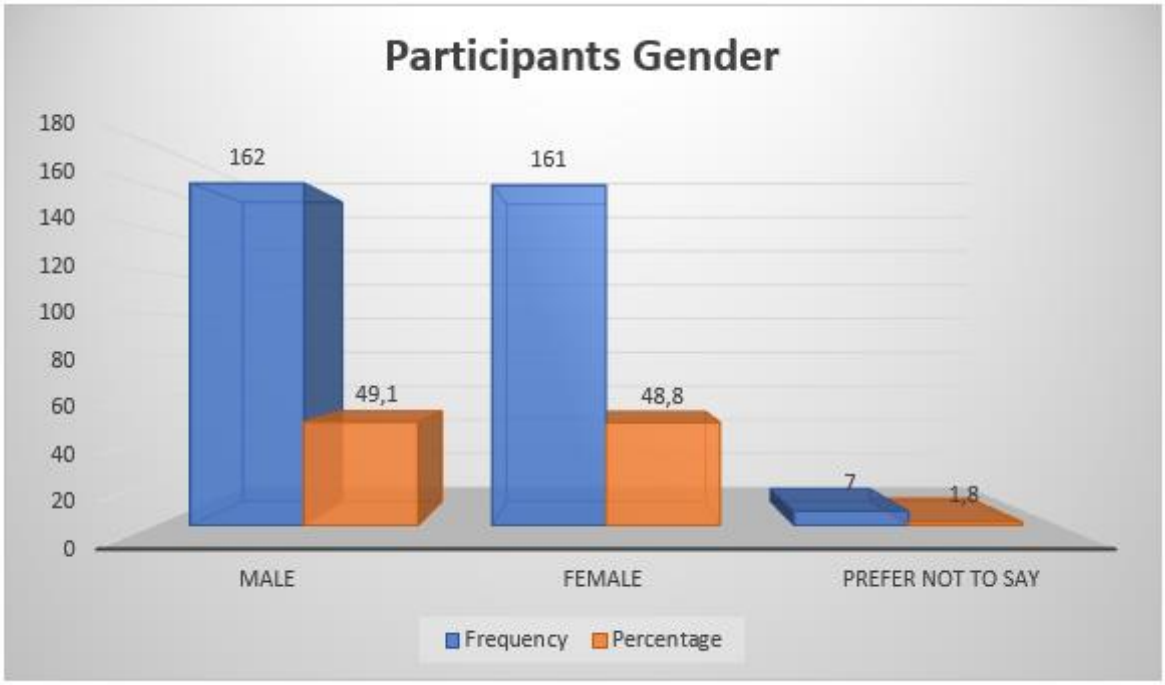
Table 4-4: Participants Age

AGE				
	Frequency	**Cumulative Frequency**	**Percent**	**Cumulative Percent**
17-24	174	174	52.7	52.7
25-30	125	299	37.9	90.6
31-35	28	327	8.5	99.1
+35	3	330	0.9	100

4.5.2 Participants Gender

The second piece of information that was asked from the participants to provide on the questionnaire was their respective gender. The distribution of gender was almost equal between male and female apart from those who chose not to disclose their gender. Figure 4.1 below depicts that majority of respondents were male, which represents 49.1% (n=162) of the sample population. Females came in second and represented 48.8% (n=161) of the sample population and some participants chose not to disclose their gender and only constituted to 1.8% (n=7).

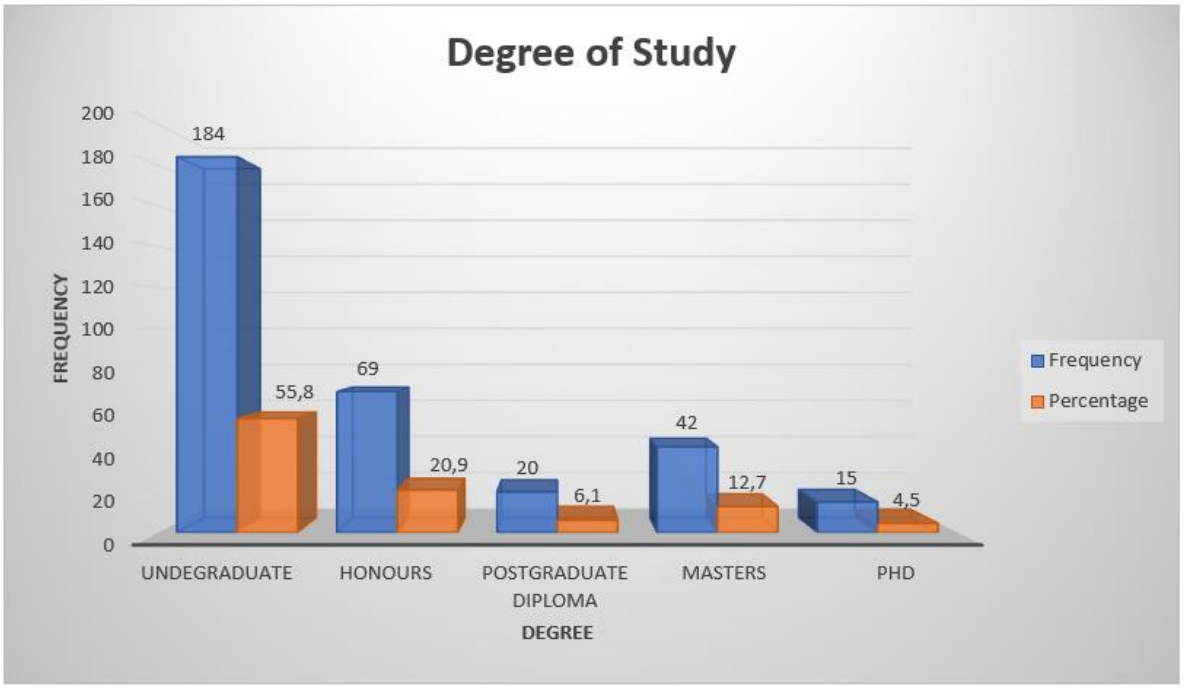
Figure 4-1: Participants Gender



4.5.3 Degree of Study

The participants were asked to indicate the degree they were enrolled in at UKZN at the time. The highest number of respondents were undergraduates, which was 55.8% (n=184). The second highest number of participants were honours students, which consisted of 20.9% (n=69). Following here was participants who are registered for a master's degree with 12,7% (n=42). Participants registered for a postgraduate diploma came in fourth with 6,1% (n=20) and PhD registered candidate had the least number of participants with just 4.5% (n=15). Figure 4.2 presents the data that was collected.

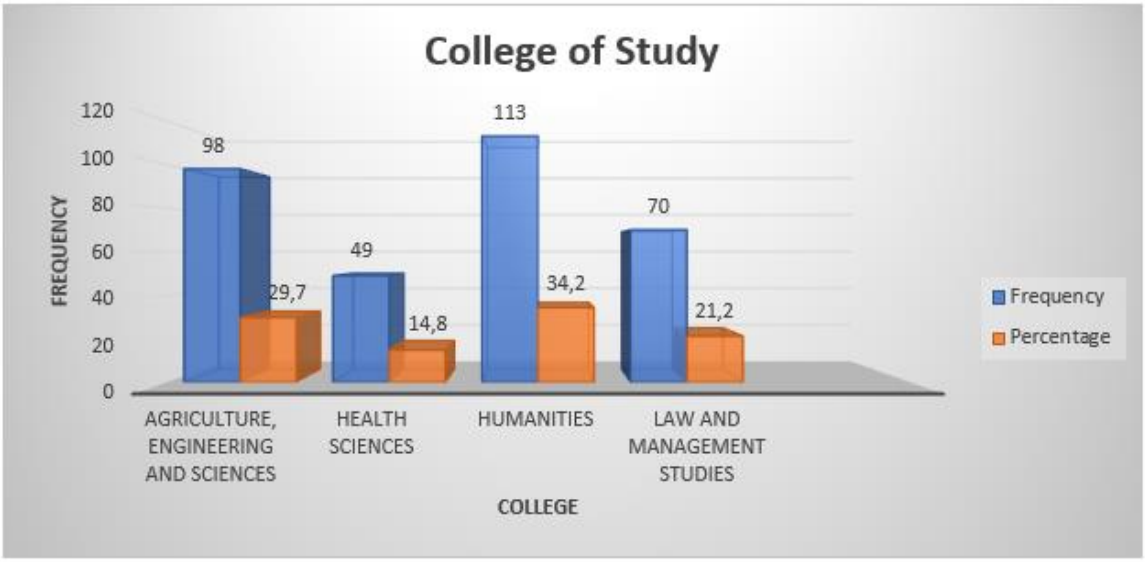
Figure 4-2: Degree of Study



4.5.4 College of Study

The majority of participants 34.2% (n=113) were from the College of Humanities. With 29,7% (n=98), the College of Agriculture, Engineering, and Sciences came in second. The College of Health Sciences had the lowest total participation rate at 14,8% (n=48), while the College of Law and Management Studies had the third-highest number of respondents with 21,2% (n=70). The outcomes based on the data gathered are shown in Figure 4.3 below.

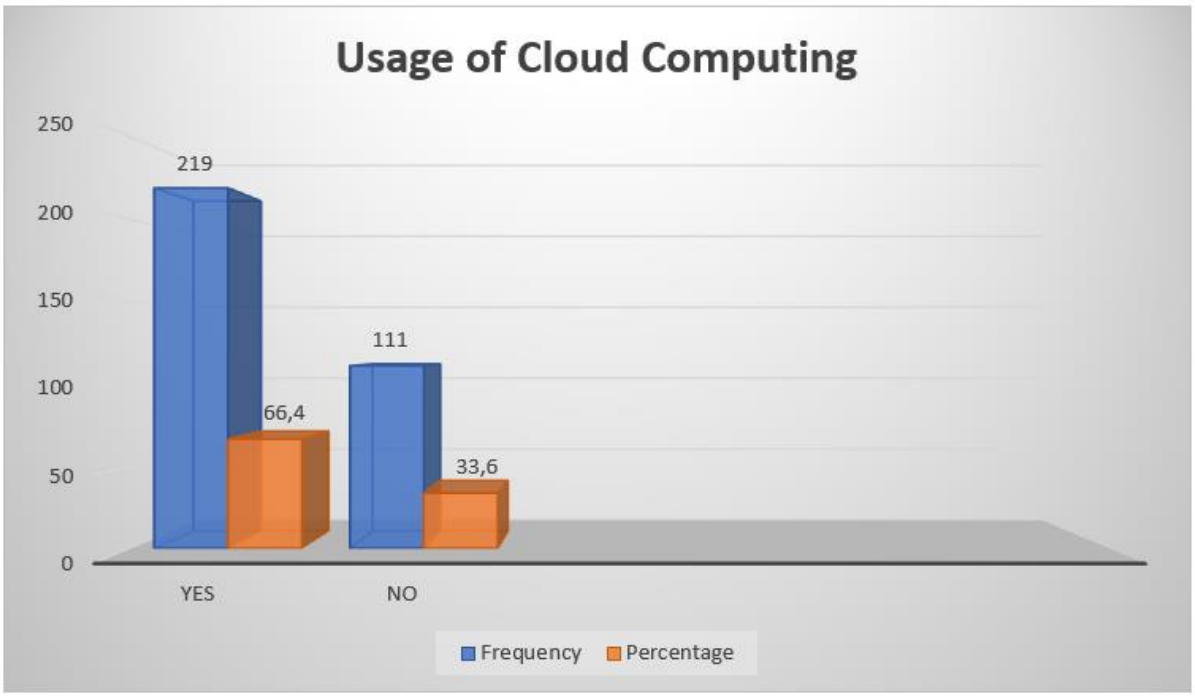
Figure 4-3: College of Study



4.5.5 Usage of Cloud Computing for Learning Purposes

Respondents were asked to state whether they use CC services for learning or not. Most participants 66,4% (n=219) of participants said they do use CC for learning purposes and only 33,6% (n=111) declared that they did not use CC for educational reasons. The respondents who stated that they do not use CC for learning purposes were asked to return their questionnaire and not to continue filling it in. Figure 4.4 below presents the results for the usage of CC.

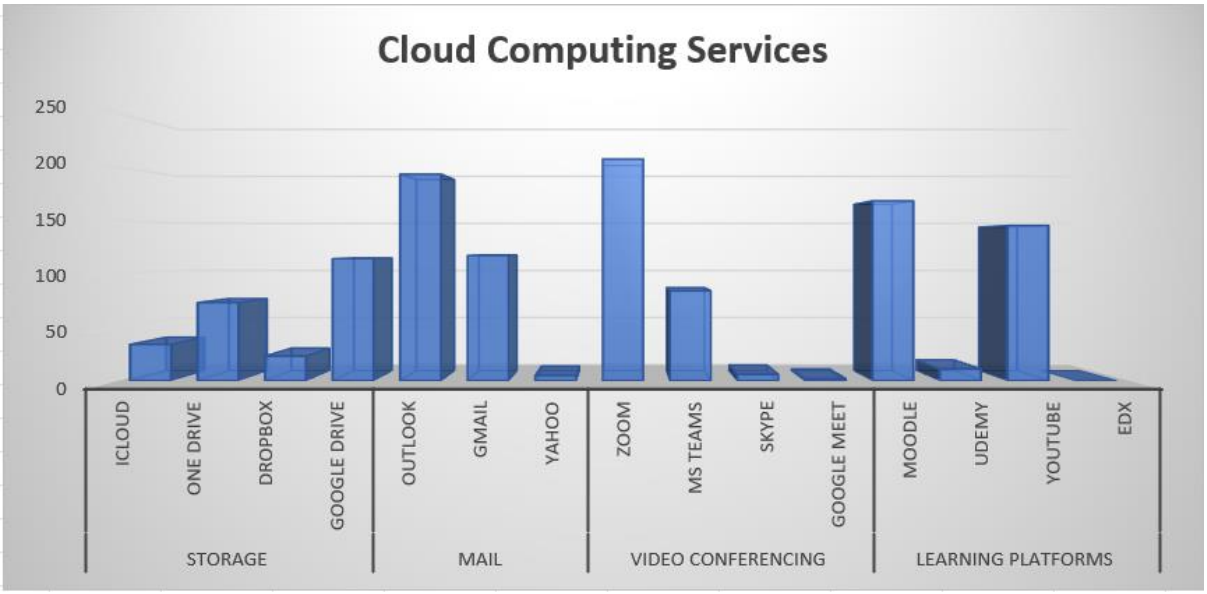
Figure 4-4: Usage of Cloud Computing



4.5.6 Services of Cloud Computing Used

Participants were asked to indicate which services of cloud computing they use for learning purpose and the resulted are presented in figure 4.5 below. Under the storage category results show that majority of students indicated that use Google Drive the most. This was followed by OneDrive; iCloud came in third and Drop Box was found to be the least used storage service. Al-Samarraie & Saeed (2018) posited that Google drive is the most used tool for cloud storage as it provides students with multiple features to list files and directories, list file revisions, and download files necessary for the collaborative process. However, these results run counter to what was found in earlier research by Osembe (2015); Moryson & Moeser (2016), where it was found that Dropbox was the most used platform for storage. The second category was mail, and Figure 11 below shows that at the UKZN PMB campus, Outlook is the most widely used mail application. The second highest used mail service was Gmail and Yahoo came in third as the least mail service used. In the video conferencing category Zoom was found to be most used application. It is no surprise that Zoom was indicated as the highest used video conferencing tools as lectures shifted online when the Covid-19 pandemic hit the world in 2020. Our findings concur with those of a research done by Mohamed, Ahmed, Hussein, Ahmed, Mohamed & Sheikh (2020) as they found that Zoom is the most commonly used video conferencing tool. Mohamed *et al.* (2020) explained that Zoom being accessible free of charge is the reason for its popularity and wide usage. In addition, Chen, Peng, Jing, Wu, Yang & Cong (2020) also found Zoom as the most commonly used platform because it provides users with the best experience and support. MS Teams was the second highest used video conferencing tool. Both Skype and Google Meet had the lowest number of participants with just 6 and 2 respectively. The final category was learning platforms Moodle came in first, followed by YouTube. Udemy came in third and EdX was the least used learning platform with zero respondents. This is due to Moodle's extensive functionality and open-source status (Abbad, 2021). Rawat & Dwivedi (2019) stated that Moodle has more than 76 million students and one million instructors using it and currently offers over eight million courses. Moodle can be utilized at colleges, universities, and even companies for a variety of learning scenarios, including blended learning, remote learning, and other e-learning platforms (Adamu, 2021).

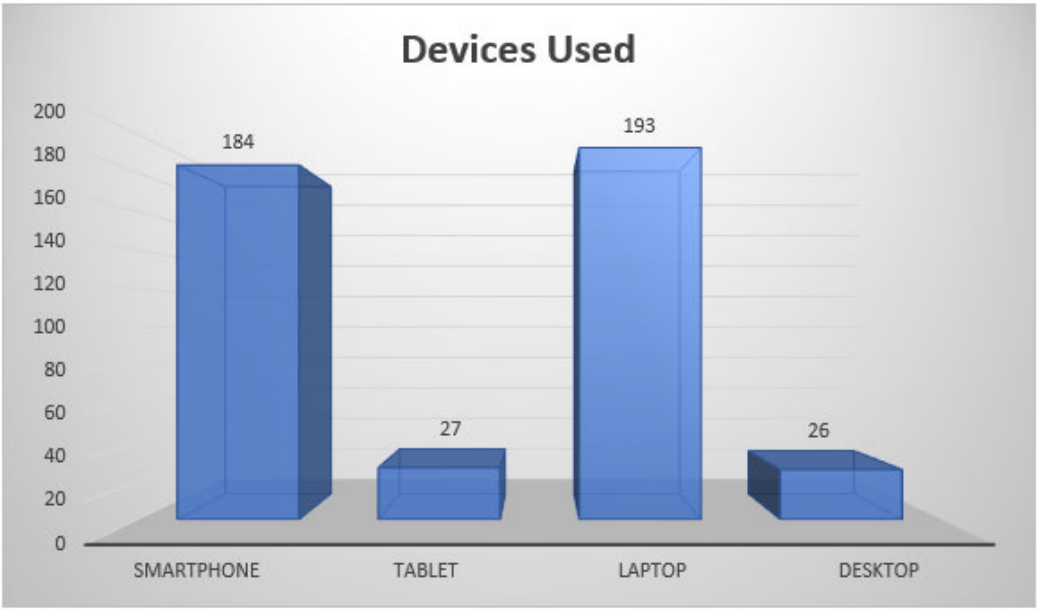
Figure 4-5: Cloud Computing Services



4.5.7 Devices Used

Participants were asked to choose devices they use to access CC services for learning purposes. Each participant had an option to choose multiple devices as there is a possibility that they own and use more than one device to access CC services. Figure 4.6 below shows that of the 219 participants who said they use CC for learning purposes 189 use smartphones, 27 use tablets, 193 use laptops and 26 use desktops. These results are in line with those from El Firdoussi, Lachgar, Kabaili, Rochdi, Goujdami & El Firdoussi (2020) who assessed distance learning in HEIs during the Covid-19 Pandemic and found that laptops were the widely used devices followed by smartphones. It is no surprise that laptops and smartphones had the highest number of users because of they are portable, easy to use and easily accessible to students as they most likely own one or both of these devices. These devices make it easy to access CC services such as learning materials, activities, university services in actual time 24/7 from anywhere in the world (Almaiah *et al.*, 2019; Ali, 2020). Pardeshi (2014) stated that these devices provide students with the mobility to read their textbooks, view the syllabus and even do their homes. Figure 4.6 below depicts the results of the devices used.

Figure 4-6: Devices Used



4.6 Responses Based on the Constructs

4.6.1 Performance Expectancy

According to Venkatesh *et al.* (2003) a person's performance expectancy is how much they believe utilizing the system would help them perform better at work. Venkatesh *et al.* (2003) posited that potential users will be highly motivated to adopt the technology if they think that CC adoption will be useful. In this study, the degree to which students agreed with the performance expectations of using CC for educational purposes was examined using four statements labelled as PE1-PE4, the findings are presented in table 4.5 below.

PE1- Participants were requested to rate the extent to which they agreed with the statement that CC is useful for learning. The findings indicate that 79,5% (Strongly agree% + Agree%) of students agree using CC is useful for learning. However, 17,8% of the respondents were neutral and 2,7% (Strongly disagree% + Disagree%) of the respondents did not find CC learning useful.

PE2-The results of this statement indicated that 70,4% (Strongly agree% + Agree%) respondents agree that using CC enhances their motivation to learn. 18,7% were neutral and a total of 11% (Strongly disagree% + Disagree%) disagreed with this statement.

PE3-In this statement participants were asked to rate the level of which they agree or degree with CC increasing their productivity when they use it for learning. The results show that 72,2% (Strongly agree% + Agree%) agree with this statement. However, 12,5% disagreed (Strongly disagree% + Disagree%) and 15,5% of respondents were neutral to the statement.

PE4-The results of this show that while 79,9% (Strongly agree% + Agree%) of participants agree with the statement that using CC for learning increases their chances of passing, 5,5% (Strongly disagree% + Disagree%) disagreed with this statement and 14,6% of respondents were neutral.

Table 4-5: Performance Expectancy

Questionnaire Item	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
PE1: I find cloud computing services in my learning useful	56 25.6%	118 53.9%	39 17.8%	5 2.3%	1 0.4%
PE2: Using cloud computing services in my learning enhances my learning motivation	47 21.5%	107 48.9%	41 18.7%	21 9.6%	3 1.4%
PE3: I think using cloud computing services in my learning will increase my learning productivity	54 24.7%	104 47.5%	34 15.5%	25 11.4%	2 0.9%
PE4: Using cloud computing services in my learning increases my chance of passing	67 30.6%	108 49.3%	32 14.6%	9 4.1%	3 1.4%

4.6.2 Effort Expectancy

The term "effort expectancy" refers to how simple a system is to use (Venkatesh *et al.*, 2003). Users are more likely to adopt and accept CC if they believe it to be user-friendly, adaptable, and requires less time to learn how to make use of the system efficiently (Venkatesh *et al.*, 2003). Participants in this study were asked to indicate how strongly they agreed or disagreed with each of the four statements relating to effort expectancy labelled as EE1-EE4 on table 4.6 below.

EE1- This measures how much respondents agree or disagree with the statement that they find using CC for learning easy to use. 67,6% (Strongly agree% + Agree%) agreed with statement while 9,2% (Strongly disagree% + Disagree%) disagreed and 23,3% of respondents were neutral.

EE2- Here respondents were tasked with rating the statement of whether or not learning how to use CC tools is easy for them. A majority 67,5% (Strongly agree% + Agree%) of respondents agreed with this statement while 9,6% (Strongly disagree% + Disagree) disagreed and 22,8% of respondents were neutral.

EE3- The results of this statement show that 70,4% (Strongly agree% + Agree%) agree that becoming skilful at using for CC for learning is easy for them. 4,2% (Strongly disagree% + Disagree) disagreed with this and 25,6% of respondents remained neutral.

EE4- This statement measures if the respondent's interaction with CC is clear and understandable. 67,5% (Strongly agree% + Agree%) of respondents agreed with statement while 11,5% (Strongly disagree% + Disagree) disagreed and 21% remained neutral.

Table 4-6: Effort Expectancy

Questionnaire Item	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
EE1: I find cloud computing services in my learning easy to use	63 28.8%	85 38.8%	51 23.3%	19 8.7%	1 0.5%
EE2: Learning how to use cloud computing in my learning services is easy for me	59 26.9%	89 40.6%	50 22.8%	19 8.7%	2 0.9%
EE3: It would be easy for me to become skilful at using cloud computing services in my learning	61 27.9%	93 42.5%	56 25.6%	8 3.7%	1 0.5%
EE4: My interaction with cloud computing services in my learning is clear and understandable	59 26.9%	89 40.6%	46 21.0%	24 11.0%	1 0.5%

4.6.3 Facilitating Conditions

As posited by Venkatesh *et al.* (2003) the facilitating condition is the extent to which one believes that the institutional and technological foundation is in place to permit the usage of the system. If someone is aware that certain facilitating factors, such as an organizational structure and technological infrastructure, are in place, their utilization of a system will be more extensive (Venkatesh *et al.*, 2003). In study respondents were asked to rate their level of agreement of whether agree or disagree with the four statements presented under the facilitating conditions labelled FC1-FC4. Table 4.7 below presents the findings.

FC1- The results of this statement show that 92,5% (Strongly agree% + Agree%) agree that they have the necessary resources for CC. 2,3% (Strongly disagree% + Disagree) disagreed with this and 8,2% of respondents remained neutral.

FC2- This measures how much respondents agree or disagree with the statement that using CC fits well with the way they like to learn. 61,7% (Strongly agree% + Agree%) agreed with statement while 12,8% (Strongly disagree% + Disagree%) disagreed and 25,6% of respondents were neutral.

FC3-The results of this show that while 68,9% (Strongly agree% + Agree%) of participants agree with the statement that they have the knowledge and skills necessary to use CC for learning, 6,4% (Strongly disagree% + Disagree%) disagreed with this statement and 27,4% of respondents were neutral.

FC4-In this statement participants were asked to rate the level of which they agree or degree that there is assistance available to them when they face difficulties with CC. The results show that 63,9% (Strongly agree% + Agree%) agree with this statement. However, 10,5% disagreed (Strongly disagree% + Disagree%) and 25,6% of respondents were neutral to the statement.

Table 4-7: Facilitating Conditions

Questionnaire Item	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
FC1: I have the resources necessary in my learning to use cloud computing services	53 24.2%	143 65.3%	19 8.2%	4 1.8%	1 0.5%
FC2: I think using cloud computing services for learning fits well with the way I like to learn	47 21.5%	88 40.2%	56 25.6%	26 11.9%	2 0.9%
FC3: I have the knowledge and skills necessary in my learning to use cloud computing services	52 23.7%	99 45.2%	54 24.7%	13 5.9%	1 0.5%
FC4: If there are difficulties faced with the use of cloud computing services in my learning, there is someone available to assist	35 16.0%	105 47.9%	56 25.6%	18 8.2%	5 2.3%

4.6.4 Social Influence

Social influence is the extent to which a person believes that influential people believe they should use the new system (Venkatesh *et al.,* 2003). Users are more likely to accept new technology if others such as family members, relatives, peers, and close friends believe that utilizing it is beneficial and worthwhile (Venkatesh *et al.*, 2003). The results are depicted on table 4.8 below.

SI1- Here respondents were tasked with rating the statement of whether or not people who are important to the encourage the use of using CC for learning. A sum of 62,5% (Strongly agree% + Agree%) of respondents agreed with this statement while 8,7% (Strongly disagree% + Disagree) disagreed and 28,8% of respondents were neutral.

SI2- The results of this statement show that 62,5% (Strongly agree% + Agree%) agree that people who influence their behaviour advocate for the use of CC for learning. 9,6% (Strongly disagree% + Disagree) disagreed with this and 27,9% of respondents remained neutral.

SI3-In this statement participants were asked to rate the level of which they agree or degree that their social circle encourage them to use CC for learning purposes. The results show that 69% (Strongly agree% + Agree%) agree with this statement. However, 7,3% disagreed (Strongly disagree% + Disagree%) and 23,7% of respondents were neutral to the statement.

SI4- This measures how much respondents agree or disagree with the statement that the university supports and encourages the use of CC in learning. 81,3% (Strongly agree% + Agree%) agreed with statement while 4,6% (Strongly disagree% + Disagree%) disagreed and 14,2% of respondents were neutral.

Table 4-8: Social Influence

Questionnaire Item	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
SI1: People who are important to me think that I should use cloud computing services in my learning.	39 17.8%	98 44.7%	63 28.8%	16 7.3%	3 1.4%
SI2: People who influence my behaviour think I should use cloud computing services in my learning	34 15.5%	103 47.0%	61 27.9%	18 8.2%	3 1.4%
SI3: Overall, my social circle supports the usage of cloud computing services.	37 16.9%	114 52.1%	52 23.7%	13 5.9%	3 1.4%
SI4: In general, the university supports the use of cloud computing services	61 27.9%	117 53.4%	31 14.2%	7 3.2%	3 1.4%

4.6.5 Behavioural Intention

The degree to which a person has made deliberate decisions about whether or not to engage in a particular future behaviour is known as behavioural intention (Venkatesh *et al.*, 2003). "It is well-established that the behavioural intention to adopt a new technology can be fundamentally translated into actual behaviour, thus the stronger the intention to perform a behaviour the stronger the behaviour would be likely to be performed" (Jaradat *et al.*, 2020, p.8291). Table 4.9 below represents the results.

BI1- This measures how much respondents agree or disagree with the statement that they intend to use CC in their learning. 68% (Strongly agree% + Agree%) agreed with statement while 6,9% (Strongly disagree% + Disagree%) disagreed and 25,1% of respondents were neutral.

BI2- In this statement participants were asked to rate the level of which they agree or degree that they predict they will use CC for learning in the future. The results show that 63,5% (Strongly agree% + Agree%) agree with this statement. However, 11,4% disagreed (Strongly disagree% + Disagree%) and 25,1% of respondents were neutral to the statement.

BI3- The results of this statement show that 64,4% (Strongly agree% + Agree%) agree that they plan to use CC in their learning. 10,1% (Strongly disagree% + Disagree) disagreed with this and 25,6% of respondents remained neutral.

Table 4-9: Behavioural Intention

Questionnaire Item	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
BI1: I intend to use cloud computing services in my learning	55 25.1%	94 42.9%	55 25.1%	10 4.6%	5 2.3%
BI2: I predict I will use cloud computing services in my learning in the future	51 23.3%	88 40.2%	55 25.1%	20 9.1%	5 2.3%
BI3: I plan to use cloud computing services in my learning	55 25.1%	86 39.3%	56 25.6%	12 7.8%	5 2.3%

4.6.6 Use Behaviour

UB1- With this statement participants were asked to rate the level of which they agree or degree that they are regular users of CC for learning purposes. The results show that 73,1% (Strongly agree% + Agree%) agree with this statement. However, 2,3% disagreed (Strongly disagree% + Disagree%) and 24,7% of respondents were neutral to the statement.

Table 4-10: Use Behaviour

Questionnaire Item	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
UB1: I consider myself a regular user of cloud computing services for learning	54 24.7%	106 48.4%	54 24.7%	4 1.8%	1 0.5%

4.7 Normality Test

It is important to conduct the normality tests as it offers details on the tests that must be carried out to obtain the desired findings. Normality tests determine whether data follows a normal distribution or does not follow a normal distribution. According to (Saunders *et al.*, 2019) Any statistic with a probability of 0.05 or less implies that the data are not normally distributed, and statistics with a probability greater than 0.05 are assumed to be normally distributed.

H_0: The data set follows a normal distribution.

H_1: The data set does not follow a normal distribution.

(Where **H_0** is the null hypothesis and **H_1** is the alternative hypothesis)

The results of the Kolmogorov-Smirnov and Shapiro-Wilk tests revealed that none of the variables' data followed a normal distribution, with a significant value of less than 0.05 indicating a rejection of **H_0**.

The inferential statistics tests that should be conducted for the data collected are non-parametric tests. The results for the normality tests are presented on table 4.11 below.

Table 4-11: Tests of Normality

	Kolmogorov-Smirnov			Shapiro-Wilk		
Construct	**Statistic**	**Df**	**Sig**	**Statistic**	**Df**	**Sig**
PE	.199	219	<,001	.911	219	<,001
EE	.186	219	<,001	.920	219	<,001
FC	.149	219	<,001	.952	219	<,001
SI	.184	219	<,001	.934	219	<,001
BI	.204	219	<,001	.906	219	<,001

4.8 Correlation

There are a number of different indices (coefficients) that can be used to calculate how closely two variables are correlated, but the top three are Kendall's tau coefficient (τ), Pearson's tau coefficient (r), and Spearman's rho coefficient (r_s) (Hauke & Kossowski, 2011). The Spearman's rho coefficient, a non-parametric test used when data is not normally distributed, was utilized in this investigation. Hauke & Kossowski (2011, p.89) defined the Spearman's rho as "a nonparametric (distribution-free) rank statistic proposed as a measure of the strength of the association between two variables".

4.8.1 Spearman Rho Correlation Between PE and BI

The performance expectancy (PE) construct in this study consists of four variables, whereas the behavioural intention (BI) construct consists of three variables. A Spearman's rho correlation test was conducted between the two constructs PE and BI. The findings indicate a statistically significant substantial correlation between students' behavioural intention to utilize CC for learning and their performance expectation of using CC for learning r_s= 0.707, p<0,01. As a result, the null hypothesis of no association may be rejected, proving that PE and BI are positively correlated. The results are depicted on table 4.12 below and this was the highest strongest relationship from all the variables.

Table 4-12: Correlation Between Performance Expectancy and Behavioural Intention

			PE	BI
Spearman's rho	PE	Correlation Coefficient	1.000	.707**
		Sign. (2-tailed)		<,001
		N	219	219
	BI	Correlation Coefficient	.707**	1.000
		Sign. (2-tailed)	<,001	
		N	219	219

The current study's findings regarding the significance of PE is consistent with research results from several research conducted on various IT fields Ababneh (2016); Kropf (2018); Rahi, Ghani & Ngah

(2018); Jaradat *et al.* (2020) where it was shown that performance expectancy has an important positive effect on the behavioural intention to adopt CC. Ooi, Lee, Tan, Hew & Hew (2018) posited Perceived Usefulness in the TAM by Davis (1989) shares the same characteristics as performance expectancy therefore implying that if students at UKZN PMB campus perceive CC as useful in their learning then they will most likely intend to use CC.

4.8.2 Spearman Rho Correlation Between EE and BI

In this study, the behavioural intention (BI) construct is made up of three factors, while the effort expectancy (EE) construct is made up of four variables. A Spearman's rho correlation test was conducted between the two constructs EE and BI. The findings indicate a statistically significant correlation between students' expected effort in using CC for learning and their behavioural intention to do so r_s= 0.685, p<0,01. As a result, the null hypothesis of no association may be rejected, proving that EE and BI are positively correlated. The results are depicted on table 4.13 below and this was the second highest strongest relationship from all the variables.

Table 4-13: Correlation Between Effort Expectancy and Behavioural Intention

			EE	**BI**
Spearman's rho	EE	Correlation Coefficient	1.000	.685**
		Sign. (2-tailed)		<,001
		N	219	219
	BI	Correlation Coefficient	.685**	1.000
		Sign. (2-tailed)	<,001	
		N	219	219

Almaiah *et al.* (2019); Jaradat *et al.* (2020) found that effort expectancy has an important positive effect on the behavioural intention to adopt CC which is consistent with the findings of this study. Venkatesh *et al.* (2003) claimed that this component was developed from the Technology Acceptance Model's recommended perceived ease of use factor by (Davis, 1989). As a result, it is implied that students at the UKZN PMB campus will be more inclined to use CC if they believe it to be simple to use in their study.

4.8.3 Spearman Rho Correlation Between FC and UB

The use behaviour (UB) construct in this study consists of one variable, while the facilitating conditions (FC) construct has four variables. A Spearman's rho correlation test was conducted between the two constructs FC and UB. The findings demonstrate a statistically significant substantial relationship between the facilitating condition and CC use behaviour for learning r_s= 0.642, p<0,01. As a result, the null hypothesis of no association may be rejected, proving that FC and UB are positively correlated.

The results are depicted on table 4.14 below and this was the fourth highest strongest relationship from all the variables.

Table 4-14: Correlation Between Facilitating Conditions and Use Behaviour

			FC	UB
Spearman's rho	FC	Correlation Coefficient	1.000	.642**
		Sign. (2-tailed)		<,001
		N	219	219
	UB	Correlation Coefficient	.642**	1.000
		Sign. (2-tailed)	<,001	
		N	219	219

The extent of use will rise if a person is aware that certain facilitating conditions, such as an organizational structure and technological infrastructure, are in place (Jaradat *et al.*, 2020). The findings of this study are in line with several previous studies that have shown that facilitating conditions strongly influence the adoption of CC behaviours (Jaradat *et al.*, 2020; Abbad, 2021; Al Fajri, Panjaitan & Hanes, 2021).

4.8.4 Spearman Rho Correlation Between SI and BI

The social influence (SI) construct in this study consists of four factors, while the behavioural intention (BI) construct consists of three variables. A Spearman's rho correlation test was conducted between the two constructs SI and BI. The results show that there is a statistically significant strong relation between student's social influence of CC for learning purposes and their behavioural intention to use CC for learning purposes r_s= 0.614, p<0,01. As a result, the null hypothesis of no association may be rejected, proving that SI and BI are positively correlated. The results are depicted on table 4.15 below and this was the fifth strongest relationship from all the variables.

Table 4-15: Correlation Between Social Influence and Behavioural Intention

			SI	BI
Spearman's rho	SI	Correlation Coefficient	1.000	.614**
		Sign. (2-tailed)		<,001
		N	219	219
	BI	Correlation Coefficient	.614**	1.000
		Sign. (2-tailed)	<,001	
		N	219	219

This outcome is consistent with research from Kayali & Alaaraj (2020), which showed that social influence significantly influenced people's intentions to adopt CC. This suggests that if other people think their behaviour is appropriate, respondents would be greatly encouraged to adopt and utilize cloud technology (Jaradat *et al.*, 2020). In actuality, one's behaviour or opinions can be significantly modified and shaped by the factor of social influence (Jaradat *et al.*, 2020).

4.8.5 Spearman Rho Correlation Between BI and UB

In this study, the behavioural intention (BI) is made up of three variables and the use behaviour is made up of one variable. A Spearman's rho correlation test was conducted between the two constructs BI and UB. According to the findings, there is a statistically significant high correlation between students' behavioural intentions to use CC for learning and their actual use r_s= 0.686, p<0,01. As a result, the null hypothesis of no association may be rejected, proving that BI and UB are positively correlated. The results are depicted on table 4.16 below and this was the third strongest relationship from all the variables.

Table 4-16: Correlation Between Behavioural Intention and Use Behaviour

			BI	UB
Spearman's rho	BI	Correlation Coefficient	1.000	.686**
		Sign. (2-tailed)		<,001
		N	219	219
	UB	Correlation Coefficient	.686**	1.000
		Sign. (2-tailed)	<,001	
		N	219	219

This is the aspect affecting technology's UB that is most crucial (Wijaya *et al.*, 2022). The results are in line with findings obtained by studies from Alkhater, Wills & Walters (2017); Kayali & Alaaraj (2020); Abbad (2021) where it was demonstrated that behavioural intention has the most favourable impact on the actual use of CC.

4.9 Discussion of Findings

In light of the study's research questions, this part presents the conclusions drawn from the data collected for the study.

Research Question 1:What is the student's current usage of CC for learning purposes?

The first objective of the research was to establish the current usage of CC at the UKZN PMB campus. As the results were presented in this chapter a higher percentage (66.4%) of students currently uses cloud computing for learning purposes at UKZN PMB campus. In terms of storage services Google drive proved to be the most widely used cloud-based storage service with a total of 114 (52%) out 219 respondents. For emails outlook was the most widely used form of email communication which did not come as a surprise because the Microsoft outlook is the university's official email service. 193 (88.1%) out of 219 respondents said they use MS outlook for emails. In terms of video conferencing applications majority of students said Zoom was the main application they use. This was shortly introduced after Covid-19 pandemic hit in 2020 and because of social distancing face-to-face lectures were cancelled and universities were forced to produce solutions to continue with the learning. 207 (94.5%) out of 219 students said they use Zoom for video conferencing. For learning platforms Moodle was the most used

application. This is also not surprising as Moodle is the learning platform UKZN PMB uses to post assignments, lecture notes, announcements etc. 168 (76.7%) out 219 students said to use Moodle as their learning platform.

Research Question 2:What factors influence student's intention to adopt CC for learning purposes?

4.9.1.1 Performance Expectancy

The degree to which a person thinks that using the system will allow him or her to increase their performance at work was defined as performance expectancy in this study. In the UTAUT model, the construct of PE is frequently used to predict BI to use ICT systems (Almaiah *et al.*, 2019). The university will be better able to determine what needs to be done to encourage student adoption by understanding the factors that influence the adoption of CC in HEIs. The research findings indicated that student's behavioural intention (BI) to use CC for learning purposes is significantly and positively influenced by performance expectancy (PE) r_s= 0.707, p<0,01. This means that students are far more likely to accept and utilize CC for learning purposes if they believe that the activities and tasks relevant to their learning would improve. These results are in line with many other studies Venkatesh *et al.* (2003); Almaiah *et al.* (2019); Emmanuel (2019); Wijaya *et al.* (2022) which posited that PE has a significantly positive influence on BI to adopt CC.

4.9.1.2 Effort Expectancy

Effort expectancy is a term that describes how simple a system is to use (Venkatesh *et al.*, 2003). It is a crucial element of the UTAUT framework and is frequently utilized to determine how willing consumers are to adopt new technology (Almaiah *et al.*, 2019). Users are more likely to adopt and accept CC if they believe it to be user-friendly, adaptable, and requires less time to learn how to make use of the system efficiently (Venkatesh *et al.*, 2003). The research findings indicated that student's behavioural intention (BI) to use CC for learning purposes is significantly and positively influenced by effort expectancy (PE) r_s= 0.685, p<0,01. This means that students are far more likely to accept and utilize CC for learning purposes if they believe that it is user friendly, adaptable and can be learnt in a shoer period. These results are in line with many other studies Venkatesh *et al.* (2003); Rastogi *et al.* (2018); Jaradat *et al.* (2020) which posited that EE has a significantly positive influence on BI to adopt CC.

4.9.1.3 Facilitating Conditions

As posited by Venkatesh *et al.* (2003) the degree to which one thinks the organizational and technological foundation is in place to permit the use of the system is the facilitating condition. If someone is aware that certain facilitating factors, such as an organizational structure and technological infrastructure, are in place, their utilization of a system will be more extensive. (Venkatesh *et al.*, 2003). The research findings indicated that student's usage behaviour (UB) for CC for learning purposes is

significantly and positively influenced by facilitating conditions (FC) r_s= 0.642, p<0,01. Various empirical studies have shown that the presence of appropriate facilitating conditions can serve as a positive motivator for users to adopt technology (Venkatesh *et al.*, 2003; Jaradat *et al.*, 2020). In other words, one's behaviour or attitudes can change and be formed as a result of social influence (Jaradat *et al.*, 2020). These results are in line with many other studies Rastogi *et al.* (2018); Puspitasari, Firdaus, Haris & Setyadi (2019); Wijaya *et al.* (2022) which posited that FC has a significantly positive influence on the UB of CC.

4.9.1.4 Social Influence

The Social influence is the extent to which someone accepts that influential others think they should employ the new strategy (Venkatesh *et al.*, 2003). "The individual's behaviour is influenced by the way in which they believe others will view them as a result of having used the technology" (Venkatesh *et al.*, 2003, p.451). The research findings indicated that student's behavioural intention (BI) to use cloud computing (CC) for learning purposes is significantly and positively influenced by social influence (SI) r_s= 0.614, p<0,01. This indicates that if people thought they were acting appropriately, respondents would be highly inclined to adopt and use cloud technology (Jaradat *et al.*, 2020). In other words, one's behaviour or attitudes can change and be formed as a result of social influence (Jaradat *et al.*, 2020). These results are in line with many other studies Rastogi *et al.* (2018); Puspitasari *et al.* (2019); Wijaya *et al.* (2022) which posited that SI has a significantly positive influence on BI to adopt CC.

Research Question 3:What is the behavioural intention of students to adopt CC for learning purposes?

The degree to which a person has made deliberate decisions about whether to engage in a particular future behaviour has been described as behavioural intention (Venkatesh *et al.*, 2003). It is well known that the behavioural intention to adopt a new technology can fundamentally transfer into actual behaviour, so the more strongly one intends to behave, the more likely one is to act in that manner (Davis, 1989). BI together with FC were measured against UB. BI was found to be the highest influential construct for actual usage. BI was found to be r_s= 0.686. This suggests that behavioural intention is a crucial aspect of the adoption of cloud technologies. Given that behaviour has a significant impact on usage, it logically follows that those with high levels of behaviour also had high levels of usage (Abbad, 2021).

Research Question 4:Which of the four constructs (PE, EE, SI & FC) has the most influence on students to adopt CC for learning purposes?

Performance expectancy was the construct which had the most influence on behavioural intention to adopt cloud computing for learning purposes. This finding is consistent with a study by Rahi, Abd. Ghani, Alnaser & Ngah (2018) who found PE as the most influential factors among all other UTAUT

factors (social influence, effort expectancy, and facilitating condition). In addition, in a study conducted by Puspitasari *et al.* (2019) it was found that PE is the most influential variable to predict user's BI.

4.10 Chapter Summary

The following findings were presented in the data analysis section:

- The most popular platform for storage was Google drive; for email services Microsoft Outlook was found to be the preferred application; Zoom was the most preferred tool for video conferencing and finally for learning platforms Moodle was the most widely platform.
- Students have the intention to adopt CC for learning purposes as confirmed by the positively relation to the usage behaviour of CC for learning purposes. UB was also positively influenced by the FC.
- In the constructs of the UTAUT model, which is the framework adopted in this study, it was discovered that PE is the strongest and most significant predictor to the BI to use CC for learning purposes. EE and SI also positively influenced the BI to use CC for learning purposes.

The findings of the data collection from the respondents are presented in this chapter. The data were analysed in this chapter using both descriptive and inferential statistics, and the literature was used to support the explanations of the findings. Additionally, to find correlations between constructs spearman rho tests, which are described in this chapter and were utilised and are consistent with existing literature.

5 CHAPTER FIVE: SUMMARIES, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter summarizes the findings from the preceding chapter in accordance with the study's findings, the study's conclusion, and summaries of each chapter of the dissertation. This chapter discusses the study's limitations and offers recommendations to assist higher education institutions understand the student's current usage and intent to use CC for learning in order to be able to implement CC more effectively.

5.2 Summary of the Study

In this chapter, we will focus on how the study's questions were answered and how the study's goals were met by summarising the findings of the preceding chapter. The goals of the research for this study were to:

- To determine the student's current usage of CC for learning purposes.
- To determine factors influencing student's intention to adopt CC for learning purposes.
- To determine the behavioural intention of students to adopt CC for learning purposes.
- To determine which of the four constructs (PE, EE, SI & FC) has the most influence on students to adopt CC for learning purposes.

The study consists of five chapters in total. The first chapter introduced the study by proving a background of CC. It further outlined the problem statement, research questions and research objectives. The theoretical framework used on the study was also briefly discussed. The chapter further delineated the significance and limitations of the study.

The second chapter is the literature review which presented a summary of the body of work already done on the subject of CC adoption in HEIs. An overview of CC was given in the first section of this chapter. Furthermore, the challenges and benefits of adopting CC in HEIs were discussed together with the factors influencing the adoption of CC. Toward the end of the chapter various technology adoption theories were also discussed. Finally, the impact of Covid-19 in education was discussed and the chapter was concluded.

In chapter three, the researcher discussed the methods used to undertake this study. Research design, research philosophy, research approach, research method, research strategy are all components of research methodology that were discussed. Additionally, sampling methods, data collection and data were further discussed in this chapter.

Chapter four is the data analysis chapter which presented all the findings of the research study being undertaken. The chapter first discussed the response rate and the reliability tests and validity. This is

followed by the descriptive analysis which detailed the demographics of the participants. The chapter further looked at the responses gathered based on the constructs of the framework used, normality tests and correlation of all the framework's constructs. In order to conclude the chapter, it presented a discussion of the findings with regards to the research questions stated in the first chapter.

5.3 Summary of Major Findings

Regarding the usage of CC for learning purposes the study found that majority of the surveyed sample population stated that they do utilise CC for learning. As alluded in chapter four the survey divided the CC services into four categories namely, storage, mail, video conferencing and learning platforms. Google drive, Microsoft Outlook, Zoom and Moodle were found to be the leading applications in all the categories mentioned above respectively.

The most commonly used devices to access these CC services were laptops and smartphones. This is no surprise as Gilbert (2020) posited that according to the Independent Communications Authority of SA (ICASA), South Africa's smartphone penetration climbed from 81.7% in 2018 to 91.2% in 2019. Which means that more people had access to or owned a smartphone. During the peak of Covid-19 the minister of Higher education, Mr Blade Nzimande mandated that the National Student Financial Aid Scheme (NSFAS) issued laptops to all the students who are currently funded (SA-News.gov.za, 2021). This then allowed even students who come from disadvantaged backgrounds to be able to own a laptop thus increasing the number of students who own laptops and use them to access CC for learning purposes.

This research study also found that all the constructs from the UTAUT model, which was the framework used for this study, had a significant positive effect on both the Behavioural intention to use and the actual usage behaviour of CC for learning purposes. Performance expectancy had the strongest effect sized amongst all the observed UTAUT constructs. This research provided evidence from previous studies which supported the findings stated previously.

5.4 Limitations of the Study

The most notable limitation was that the study was only conducted in one of the five UKZN campuses which is the Pietermaritzburg campus. This was because of the lack of funds to be able to conduct the survey from all the other campuses as well which are situated in the Durban location at the Kwa-Zulu Natal province. Second, the moderating impact of age, gender, and experience was not examined in this study, which may have affected how the students used CC. This presents an opportunity for future research to use these moderators gain an understanding of how they might influence the use of CC. Thirdly this study was conducted during the Covid-19 pandemic and the access to students was not as desirable as it would have been if we were not in the pandemic. Finally, this research was focused on student's only, but they are not the only users of CC within the university's structure. Therefore, there

is an opportunity for future research. Lectures, administrative staff, tech support staff etc might be the focus of future research to gain the perspective of their view on the usage of CC within HEIs.

5.5 Recommendations

The main aim of this study was to understand the factors influencing the adoption of cloud computing in higher education during coronavirus disease at UKZN PMB campus. As seen during the Covid-19 pandemic, the formal setting of the learning environment can change suddenly, and universities must have strategies in place to deal with these changes.

First, the university's decision-makers must provide enough financial and technological resources to support the use of CC for educational purposes. In providing these resources, universities are encouraging students to use CC for educational purposes to enhance their academic performance.

Second, as this has an impact on students' performance and learning efficiency, decision-makers and the developers of CC learning tools should collaborate to ensure that these tools are focused on crucial factors that are crucial for students to adopt CC for learning purposes.

Student's awareness of CC for educational purposes together with computer skills should be developed by the university. The provision of training courses can ensure that students understand what CC for learning is, how it benefits them, and they can use it effectively.

5.6 Future Research

- Future research could study the four campuses which were not utilised in this study. This will give better generalization of the whole university on the student's intent to adopt CC for learning purposes.
- Studying a similar topic as the one of this study throughout the university (all five campuses) will assist the university's decision makers to understand the overall student's intent to adopt CC for learning purposes. This will then enable them to create policy recommendations and plans to assist students in this and any future pandemics.
- This study used a small convenience sample, because of the lack of funds to expand the study to other campuses as well. Future research could expand both the size and population sample.
- The moderating effects of gender, age, and experience were not examined in this study, and these factors may the student's adoption of CC for educational purposes. This presents the opportunity for future research to ascertain the impact of gender, age, and experience on the BI of students' adoption of CC for educational purposes.

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7 APPENDICES

APPENDIX A: CONSENT FORM

UNIVERSITY OF KWAZULU-NATAL

School of Management, IT & Governance

Research Project

Researcher: Minenhle Zondi, +27 (0) 81 532 3618, Email: 212507681@stu.ukzn.ac.za

Supervisor: Dr. Surika Civilcharran +27 (0) 33 260 8023, Email: civilcharran@ukzn.ac.za

Research Office: **Humanities & Social Sciences Research Ethics Administration**, Govan Mbeki Building, Westville Campus, Tel: +27 (0) 31 260 8350, Email: HSSREC@ukzn.ac.za

CONSENT

I_____ (full names of participant) hereby confirm that I understand the content of this document and the nature of the research project, and I consent to participating in the research project. I understand that I am at liberty to withdraw from the project at any time, should I so desire.

_____ _____

Signature of participant Date

This page is to be retained by researcher.

APPENDIX B: QUESTIONNAIRE

UNIVERSITY OF KWAZULU-NATAL

School of Management, IT & Governance

Dear Respondent,

Master's Research Project

Researcher: Minenhle Zondi, +27 (0) 81 532 3618, Email: 212507681@stu.ukzn.ac.za

Supervisor: Dr. Surika CivilCharran, +27 (0) 33 260 8023, Email: civilcharran@ukzn.ac.za

Research Office: **Humanities & Social Sciences Research Ethics Administration**, Govan Mbeki Building, Westville Campus, Tel: +27 (0) 31 260 8350, Email: HSSREC@ukzn.ac.za

My name is Minenhle Zondi, I am an M-Com student in the School of Management, IT and Governance at the University of KwaZulu-Natal. You are being invited to consider participating in a research study entitled:

Understanding the factors influencing the adoption of cloud computing in higher education during coronavirus disease: A case of University of KwaZulu-Natal.

Your participation in the study is voluntary. You may refuse to participate or withdraw from the study at any time with no negative consequence. There will be no monetary gain from participating in this research project. Confidentiality and anonymity of records will be maintained by the researcher and the School of Management, I.T. & Governance UKZN. and your responses will not be used for any purposes outside of this study. All data collected data will be used solely for research purposes and will be destroyed after 5 years.

This study has been ethically reviewed and approved by the UKZN Humanities and Social Science Research Ethics Committee (approval number: HSSREC/00004577/2022)

This survey should take about 10 minutes to complete. Thank you for your time.

Sincerely,

_____ _____

Minenhle Zondi Date

This page is to be retained by participant.

PLEASE NOTE: CLOUD COMPUTING IS DEFINED as the practice of using:

A network of remote servers hosted on the internet to store, manage, and process data, rather than a local server or a personal computer.

SECTION A: DEMOGRAPHIC INFORMATION

Please indicate your answer by placing a tick in the appropriate box.

1. Which age group do you belong to?

17-24	25-30	31-35	+35

2. What is your gender?

Male	Female	Prefer not to say

3. What degree are you registered for?

Undergraduate	Honours	Postgraduate Diploma	Masters	PhD

4. What is your college of study?

Agriculture, Engineering and Science	Health Sciences	Humanities	Law and Management Studies

SECTION B: USAGE OF SERVICES OF CLOUD COMPUTING

5. Do you use cloud computing services for learning purposes?

Yes	**No**

***NOTE*: IF YOU'VE ANSWERED *NO* ON THE QUESTION ABOVE, PLEASE HAND IN YOUR QUESTIONNAIRE. THANK YOU FOR YOUR TIME.**

6. Please indicate the services you use for learning purposes by placing a tick next to the service (select all that apply).

Storage		**Mail**		**Video Conferencing**		**Learning Platforms**	
iCloud		Outlook		Zoom		Moodle	
OneDrive		Gmail		MS Teams		Udemy	
Dropbox		Yahoo Mail		Skype		YouTube	
Google Drive				Google Meet		EdX	

7. Which of the following devices do you use to access cloud computing for learning purposes? (Select all that apply) .

Smartphone		Tablet		Laptop		Desktop	

SECTION C: DETERMINANTS OF THE IMPACT OF CLOUD COMPUTING IN HIGHER EDCUATION INSTITUTIONS

8. PERFORMANCE EXPECTANCY

Please indicate the extent to which you agree or disagree with the following statement:

	Strongly Agree	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
8.1 I find cloud computing services in my learning useful					
8.2 Using cloud computing services in my learning enhances my learning motivation					
8.3 I think using cloud computing services in my learning will increase my learning productivity					
8.4 Using cloud computing services in my learning increases my chance of passing					

9. EFFORT EXPECTANCY

Please indicate the extent to which you agree or disagree with the following statement:

	Strongly Agree	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
9.1 I find cloud computing services in my learning easy to use					
9.2 Learning how to use cloud computing in my learning services is easy for me					
9.3 It would be easy for me to become skilful at using cloud computing services in my learning					
9.4 My interaction with cloud computing services in my learning is clear and understandable					

10. FACILITATING CONDITIONS

Please indicate the extent to which you agree or disagree with the following statement:

	Strongly Agree	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
10.1 I have the resources necessary in my learning to use cloud computing services					
10.2 I think using cloud computing services for learning fits well with the way I like to learn					

10.3 I have the knowledge and skills necessary in my learning to use cloud computing services					
10.4 If there are difficulties faced with the use of cloud computing services in my learning, there is someone available to assist					

11. SOCIAL INFLUENCE

Please indicate the extent to which you agree or disagree with the following statement:

	Strongly Agree	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
11.1 People who are important to me think that I should use cloud computing services in my learning.					
11.2 People who influence my behaviour think I should use cloud computing services in my learning					
11.3 Overall, my social circle supports the usage of cloud computing services.					
11.4 In general, the university supports the use of cloud computing services					

SECTION D: INTENTION TO ADOPT CLOUD COMPUTING IN HIGHER EDUCATION

12. BEHAVIOURAL INTENTION

Please indicate the extent to which you agree or disagree with the following statement:

	Strongly Agree	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
12.1 I intend to use cloud computing services in my learning					
12.2 I predict I will use cloud computing services in my learning in the future					
12.3 I plan to use cloud computing services in my learning					

13. USAGE BEHAVIOR

Please indicate the extent to which you agree or disagree with the following statement:

	Strongly Agree	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
13.1 I consider myself a regular user of cloud computing services for learning					

THANK YOU FOR YOUR PARTICIPATION.

APPENDIX C: ETHICAL CLEARANCE

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

24 August 2022

Minenhle Zondi (212507681)
School Of Man Info Tech & Gov
Pietermaritzburg Campus

Dear M Zondi,

Protocol reference number: HSSREC/00004577/2022
Project title: Understanding the factors influencing the adoption of cloud computing in higher education during coronavirus disease: A case of University of KwaZulu-Natal
Degree: Masters

Approval Notification – Expedited Application

This letter serves to notify you that your application received on 10 August 2022 in connection with the above, was reviewed by the Humanities and Social Sciences Research Ethics Committee (HSSREC) and the protocol has been granted **FULL APPROVAL**.

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number. PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

This approval is valid until 24 August 2023.
To ensure uninterrupted approval of this study beyond the approval expiry date, a progress report must be submitted to the Research Office on the appropriate form 2 - 3 months before the expiry date. A close-out report to be submitted when study is finished.

HSSREC is registered with the South African National Research Ethics Council (REC-040414-040).

Yours sincerely,

[redacted]

_____
Professor Dipane Hlalele (Chair)

/dd

APPENDIX D: GATEKEPPERS LETTER

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

28 July 2022

Minenhle Zondi (SN 212507681)
School of Management Information & Technology
College of Law and Management Sciences
Pietermaritzburg Campus UKZN
Email: 212507681@stu.ukzn.ac.za

Dear Minenhle

RE: PERMISSION TO CONDUCT RESEARCH

Gatekeeper's permission is hereby granted for you to conduct research at the University of KwaZulu-Natal (UKZN), towards your postgraduate degree, provided Ethical clearance has been obtained. We note the title of your research project is:

"Understanding the factors influencing the adoption of cloud computing in higher education during coronavirus disease: A case of University of KwaZulu-Natal."

It is noted that you will be constituting your sample as follows:

- by handing out questionnaires to students on the Pietermaritzburg campus.
- with a request for responses on the website. The questionnaire must be placed on the notice system http://notices.ukzn.ac.za. A copy of this letter (Gatekeeper's approval) must be simultaneously sent to (govenderlog@ukzn.ac.za) or (ramkissoonb@ukzn.ac.za).

Please ensure that the following appears on your notice/questionnaire:

- Ethical clearance number;
- Research title and details of the research, the researcher and the supervisor;
- Consent form is attached to the notice/questionnaire and to be signed by user before he/she fills in questionnaire;
- gatekeepers approval by the Registrar.

You are not authorized to contact staff and students using the 'Microsoft Outlook' address book. Identity numbers and email addresses of individuals are not a matter of public record and are protected according to Section 14 of the South African Constitution, as well as the Protection of Public Information Act. For the release of such information over to yourself for research purposes, the University of KwaZulu-Natal will need express consent from the relevant data subjects. Data collected must be treated with due confidentiality and anonymity.

Yours sincerely

[redacted]

Dr KE CLELAND: REGISTRAR