Acceptance of Online Learning through Cloud Computing platforms amongst undergraduate and postgraduate students in Dublin

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DECLARATION

I, Deepjoy Bala, declare that this Dissertation that I have submitted to Dublin Business School for the award of Masters in Business Administration (Cloud Computing) is the result of my own investigations, except where otherwise stated, where it is clearly acknowledged by references. Furthermore, this work has not been submitted for any other degree.

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ABSTRACT

The standard of modern technology of learning gives the educators an ability to find advanced learning methods and to support the development of highly professional human resource. The increase in the introduction of cloud computing technology in the academic setting creates a sense of capabilities to learn and educate the cloud-based learning services in colleges and universities. In view of this, the study aims to investigate and propose the factors that influence the acceptance of online learning through cloud computing platforms.

In order to understand the reasons for the acceptance of cloud computing in the student population, a Technology Acceptance Model was used and questions were asked to students based on constructs like perceived usefulness, perceived ease of use, cloud computing awareness, risk & security, computer self-efficacy and e-skills. The nature of the project was descriptive and these factors do have a positive impact on the students due to the innovative learning technologies, concepts and tools.

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Introduction

Education System

The act of acquiring knowledge or any skill by students through study or experience from teacher is termed as the process of learning. This means that the skill is new and unknown to the participant at that instant of time. Therefore, education or learning is considered as a fundamental foundation in the modern society. It is hence also considered as a necessity for most individual; thus, playing a vital role in the business and socio-economic growth of the country (Thanh D. Nguyen, 2014). According to Berkley University, Faculty Learning Program, Education or Learning is termed as an active process, which is built on prior knowledge and occurs in a complex social environment. The learning process also requires motivation and cognitive engagement from the participant in an authenticated context (Berkley Center of Teaching and Learning, 2017).

Education system is based on two classifications: (a) Teacher Centric and (b) Learner Centric.

(a) Teacher Centric: Teacher is the main focus of object where he/she would give the direction to the student to learn. It involves a defined in-person communication in a classroom between teachers and learners aiming to promote knowledge, increase information, improve skills, and to make a change in learners' capabilities. A certain structure is followed where the syllabus is designed and the curriculum is developed. The educator would follow the predefined pattern and would not get deviated from the motive of his/her learning. It is a process where the teacher or the educator would explain the concepts based on the subject chosen by the students and clear minimal doubts giving examples if required. Students would consider teachers as their role model and follow the

learnings in the class. This is considered as a traditional mode of education system where learning is guided and there is less scope for collaboration (A. Ramya S Gowda, 2017). This mode of education is undertaken in classrooms where all the activities are controlled by the teacher. There are subject specific teachers for a particular learning mode.

Teacher Centric learning comes with a few drawbacks as it is a traditional mode of education. The scope of collaboration is less and hence an important skill of communication is lacked amongst the students. With the linear way of engagement between the students and the teachers, the level of presence of mind in the classrooms may considerably reduce. It thus doesn't let the students to express themselves impacting the level of knowledge. A subject specific predefined teacher is allotted to students which at times could prove inefficient to students as they may face it challenging to grasp the skills from one source of learning. With also a predefined and limited syllabus, the amount of knowledge is limited to students. With the traditional education system, there are geographical barriers that needs to be considered for students (A. Ramya S Gowda, 2017).

(b) Learner Centric: Learner centric mode of education is the type where the focus of learning is shared by both student and the teacher. The educator acts as a facilitator and learning happens as per the interest of the student. Learning happens with the emphasis on the interest and the style of learning chosen by the student. It enables the student to understand the skill and captures the interests of every individual in the classroom. There is also a collaborative approach through group activities. Thus, as compared to the teacher centric mode, learner centric system enables the participants to share the information, improve communication skills and thus maintain a balanced level of skills and knowledge on a particular concept. Learning becomes interesting and interactive as peers maintain a steady level of doubt sharing (A. Ramya S Gowda, 2017).

There has been a rapid development in the information technology across the globe and people all over the world are open to accept the advancement in technology. People are willingly accepting technology for everyday purpose of producing, saving and sharing information. The undergraduate and post-graduate education are essential elements that prepare future generations to change the way of living by innovating industrial technology and improving living standards. Thus, in order to meet the substantial demand of the IT infrastructure and enhance the quality of education, the education system requires continuous innovative technology (Yousef A. M. Qasem, 2020). The adoption of internet services like social networks has increased the digital literacy amongst the student population. Therefore, e-learning and mobile learning has become popular in the recent days. Thus, the traditional education method has started to disappear owing to the automation of educational services and the emergence of personnel requirements. The virtual environment occupies a major part of the education sector; thus, restructuring the whole education system (Vadim N. Korepin, 2020). Thus, universities and colleges have to restructure their education delivery model thus moving from classroom methods to online applications.

Cloud Computing?

Cloud computing is the emerging innovation in technology that uses IT infrastructure, software & platform for businesses and individuals with minimum physical equipment and low cost (Sultan, 2010). Cloud computing technology also offers people an easy way to access and share information online. Cloud computing technology transforms the e-learning system to cloud computing vendors thus developing an advantageous model saving significant share of expenses to provide innovative educational process. (Arpaci, 2017) defined Cloud Computing as “a distributed computing technology that provides dynamically scalable

computing resources including storage, computation power, and applications delivered as a service over the Internet." Online cloud computing service providers manage the construction, maintenance & development of the education system while the learning process, content management and the delivery of resources are dealt with the educational institutions (Md. Anwar Hossain Masud, 2012). Cloud Computing is divided into three main components: Infrastructure as a service (IaaS), Platform as a service (PaaS) and Software as a service (SaaS). SaaS includes Google Drive, Dropbox, iCloud & One drive as storage applications and Google apps, Office 365 & Adobe Creative Cloud as software applications (Arpaci, 2017). Students can create and share information using google docs, spread sheets or presentations. The information can also be edited and stored online thus making it easier and accessible for students. Even in higher education systems, examinations are conducted online using platforms like Zoom, Microsoft Teams or Skype. Also, with the advancement in mobile technologies to far corners of the world, students are relying on mobile devices for quick access to information or online classes. Thus, reliance on mobile and tablet devices is a convenience factor. Also, use of laptops has increased in the universities and colleges due to their size, portability and capabilities. Unlike traditional computers, laptops and tablets are able to allow advanced computing capabilities thus allowing students to satisfy their requirements. The current age of student population is using wireless technologies and mobile devices to access the online educational platforms. These processes ensure content learning, easy communication and creative thinking amongst students (Sclater, 2010).

Covid 19 Pandemic and Adoption to Online Learning

By the end of 2019, China informed the United Nations about the emergence of a deadly virus called Corona Virus or Covid 19. After a few weeks, in January 2020 there were

reports of 82 cases outside China where the Covid 19 virus had spread. With the alarming increase of the virus across different countries, The United Nations thus declared Covid 19 a public health emergency. On March 11 2020, the United Nations deeply concerned with the increase in the number of deaths by the virus and its severity declared it as a Pandemic and asked the globe to take necessary measures. These measures included avoiding any activities which involved concentration of people in shops, cinemas, restaurants or even educational institutions. In order to not impact the school activities, important last-minute changes were required to successfully complete the academic year. These changes involved a sudden migration from classroom teaching to online educational model. Students were required to have technological connectivity through devices and tools that were essential for virtual or audio transmission to occur. Students had to quickly adapt to the dynamic way of learning provided by teachers and were required to coordinate through online courses. Both the students and educators also needed to develop and practice skills and abilities that were required to switch to online education mobility (Karina Cotero, 2020).

Cloud Computing allows the possibility to increase the availability of education to remote places. With the application of advanced technologies, cloud computing provides an exceptional platform for e-learning. The scope of cloud computing is to allow educational institutions to deliver & share materials in a new way helping students prepare their work in a high-pressure environment (K.S. Rao, 2013). Students can create & share files as google docs, spreadsheets or presentations, edit files and store any kind of academic knowledge (Arpaci, 2017). Cloud-based E-learning model allows educational institutions to provide the learning process, content management & knowledge delivery while the vendor is responsible to construct, maintain and manage the educational system. The educational institutions do not need to create any software or hardware to provide the online education. The institutions

do not need to invest money or human and material resources to design an e-learning platform. All these functions are outsourced to major cloud computing organisations who provide the cloud services (Arfan Shahzad, 2016). This cloud-based system can easily be accessed on different hardware devices that support the generation of e-learning systems (Md. Anwar Hossain Masud, 2012). Since the academic resources can be accessed using on-demand sites by the student and staff, it reduces the cost of the software license, hardware cost and management cost allowing big flexibility to the college management (Ercan, 2010). Few colleges and other educational institutions previously would face difficulties providing IT services that were flexible and scalable thus making it difficult for them to grow as a business. With the use of cloud computing technology, this arrangement can be integrated as an online platform. It also helps increase the productivity of students, staff and IT support departments (K, 2014).

Rationale Behind the Research

The focus of the research is the selection of undergraduate and post graduate students studying in colleges and universities in Dublin. The student community provides a wide range of different race, culture, background and beliefs from different areas of the world. These cultural differences and the primary education techniques taught in different countries would more likely influence the perception and behaviour of the students. Thus, the differences in culture affects the way in a student thinks or acts; affecting his/her behaviour that is socially acceptable or not (Yoonmo Sang, 2015). Consequently, the respondents which includes university or college students studying undergraduate and postgraduate courses offer an appropriate mixture providing a wider view of different social and ethnic groups accepting and adopting the latest online educational system. The analysis

could help the cloud computing service providers and institutions with factors that affect the adoption and acceptance to the innovative e-learning technology. Moreover, students are the pillars in intensely using online cloud computing platforms inside and outside their campus. They actively access various online resources and interact with peers through online video-audio platforms (Harrison H. Yang. Lin Feng, 2018). Moreover, with the adoption to online learning through cloud platforms, students develop in them a culture and knowledge of cloud computing platforms combined with skills that could later be reflected in their working environment. Thus, when these student graduate from the colleges and universities, the skills learned through usage of cloud applications could prove handy. Consequently, the cloud service providers would create benefits by involving more e-learning based applications to universities. Moreover, a low adoption and acceptance rate obtained would allow the cloud service providers to improve the quality of resources and platforms thus providing a win-to-win strategy for the tech firms.

The usage of cloud computing and its presence in the university and college education system is increasing and thus it is important to study the factors that affect its adoption and eventual learning outcomes. Existing studies have been conducted in the context of various different industry sectors. No research has been conducted focusing on the integration of the cloud technology in the education system in Ireland with a special focus on the undergraduate and post-graduate students. Hence this study aims to fill this gap. This research proposal is based on the Technology Acceptance Model developed by Davis which explains the technology adaption, in general, consisting of two main factors as Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) (Davis, 1985). This research will be based firstly on usage of cloud computing services as a depended variable and then would integrate several other

factors like Perceived Usefulness, Perceived Ease of Use, Cloud Computing Awareness, Risk and Security, Computer Self-Efficacy and E-Skills.

Research Aims and Objectives

The aim of the research is to evaluate the attitudes of students towards online cloud computing usage and understand what factors influence adoption of cloud computing applications for educational purpose.

The objective of the research can be achieved by analysing the various factors that lead to the acceptance of online cloud computing platforms amongst students in Dublin. This research proposal is based on the Technology Acceptance Model developed by Davis which explains the technology adoption, in general, consisting of two main factors as Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) (Davis, 1985). This research will be based on usage of cloud computing services and integrate several factors like Perceived Usefulness, Perceived Ease of Use, Cloud Computing Awareness, Risk and Security, Computer Self-Efficacy and E-Skills. This research thus aims to understand what influences the under-graduate and post-graduate students to use the online cloud computing platforms in the education system.

Research Question

- What are the factors that lead undergraduate and postgraduate students to use online cloud computing platforms?
- What is the degree of influence towards using online learning applications for educational purpose?

Literature Review

The focus of the literature review will be on the adoption of cloud computing applications in educational institutions and the factors that influence students to use the new technology. The literature review will cover the concept of cloud computing technology. It will also discuss the theoretical framework of Technology Acceptance Model (TAM) which was developed by (Davis, 1989) and is mainly based on two constructs such as Perceived Usefulness and Perceived Ease of Use. The discussion will also be based on other constructs like Cloud Computing Awareness, Risk and Security, Computer Self-Efficacy and E-Skills. The review is also broken down thematically to explain the transition of cloud computing and its significance in the universities. Since the research aim is to analyse the adoption of cloud computing infrastructure in the colleges and universities in Dublin, the literature review also covers the ICT structuring of the education system in Ireland.

Cloud Computing

There was a rapid increase in the floor space for data centres and its operating expenses increased during the 1900s. This led to the innovation and adoption of grid computing and virtualisation. Grid computing led users plug in and use metered utility services. With the transformation of IT infrastructure to virtualisation and data shared across the consumers; data service providers changed their business model to provide remotely managed services with a low cost. With these services becoming more in demand and distributing across the globe, there became a need for service-oriented architecture (Mariana Carroll, 2012). There also seemed to be a ‘data deluge’ received from products, sensors and satellites. The industrial and scientific communities are creating multifarious methods to deal with this ever-increasing storage issues. In this era of ‘big data’, cloud computing is gaining a

popular momentum in both academia and technological industry. Scientific workflow management systems in cloud provides functionalities such as workflow specification, process coordination, job tracking & execution and fault tolerance (Ian Foster, 2008). Consumers use cloud applications and services to share resources that can be elastically scaled up or down as required and pay only for what is used and accessed. Computing is changing the IT delivery model with reduced costs, scalability, flexibility, capacity utilisation and increased efficiency. There is a shared pool of configurable resources for processing, network, information and storage provided by cloud computing. These on demand IT resources are scalable, elastic networked infrastructure which requires minimal management effort with costs based on agreement between the cloud service provider and consumer. These applications take the form of a web-based tool that the consumer can access and use through a web browser as if locally installed on their own devices. Cloud computing services (measured services) are agreed upon a service level agreement (SLA) between the service provider and the user (enterprises or IT staff) based on the type and quality of the service (Mariana Carroll, 2012). The complexity of the underlying infrastructure lies with the third-party supplier. The hardware and software infrastructure which enables the scaling & virtualization are provided by the IT architect. There are four core layers of the cloud infrastructure which includes the hardware i.e servers & the network components, software i.e operating systems, virtualisation resources i.e enabling pool & sharing of computing resources and the cloud applications like Google Apps and OneDrive. It is the task of the service provider to create, publish and monitor the cloud-based applications for use by the user and the provider. Monitoring and management include metering, provisioning, billing, capacity planning and security to consumers which represents one of the most important layers in the cloud stack (Mariana Carroll, 2012).

The characteristics of cloud computing are listed below:

- On-demand self-service: Cloud computing services enable information resources automatically according to the usage rates and the performance of computing resources.
- Broad Network Access: Users can access the resources and information not only through computers but also through all types of devices like tablets, laptops and mobile phones.
- Resource pooling: Information can easily be shared using resources like computer network, server, operating system, database across different cloud users.
- Rapid Elasticity: Users can access the resources whenever required and release them when they are finished.
- Measured Service: Users are charged as per their usage of resources (pay-per-use model) and the resources can be optimised based on their use of cloud services and their performance (Goyal, 2014).

The cloud computing services and technologies have different deployment models based on their characteristics and purposes. These deployment models include public (external), private (internal), community, hybrid and virtual private clouds. The public cloud are models where the resources like storage and applications are made available to multiple users via web applications or services by using the internet. The service providers manage and control the resources based on an offsite location. The public models are highly scalable services with usually low on cost and pay-as-per-use service. The private cloud infrastructure is available for single organisations and is managed by third party providers. These services can be located on-site or offsite based on the type of service selected by the organisation. The private services allow the provider and the consumer more control over the cloud infrastructure thus improving security, compliance and transparency of the services. This also

includes more operational expenditure due to the maintenance and control by highly skilled IT team as compared to the public cloud (Goyal, 2014). Community cloud is defined as the type of cloud shared and controlled by various organisations with shared interests. These organisations also share similar mission, policy, security requirements and compliance considerations. The community cloud service can be managed by the organisation or any third-party providers. These services are either on-site or off-site and the members of the community can store, share and access the data via applications across the community. This type of cloud infrastructure proves to exploit the economies of scale while minimising the operational and service cost associated with private clouds and exploit the risk associated with public clouds. A hybrid infrastructure is a combination of private, public or community cloud services. These combinations are bound together by standardised or proprietary technology that allow portability of data and application. A hybrid infrastructure would mean keeping the less stringent security, legal and service level requirement to the public cloud while at the same time allowing the business-critical data and information secured and managed in the private cloud (Steve Bennett, 2009). Another deployment model is the type where the public cloud resources are used to create a private or semi-private virtual cloud usually via virtual private network (VPN) connectivity (Cloud Security Alliance, 2009).

Cloud Computing Services

In the present age of technology and educational development, cloud computing services are cost-effective that enables the quality of learning. E-learning platforms prove to be a shift in the innovation of cloud computing technology comprising of hardware and software computing resources. Within the different layers of cloud architecture, the infrastructure layer of e-learning is at the lowest level. This level consists of information

infrastructure and teaching resources like system software, information management system and universal software & hardware. The teaching resources comprise of specific training materials and are distributed in the educational structure. The physical server, data storage and network then form a virtualisation group through cloud-based e-learning model. The software resources help in developing a variety of specialised applications. The interaction between the software and hardware resources is mainly managed by the resource management layer. There are three different types of service layer defined as IaaS (Infrastructure as a Service), PaaS (Platform as a Service) and SaaS (Software as a Service) (Md. Anwar Hossain Masud, 2012).

Infrastructure as a Service (IaaS)

Consumers are allowed to deploy and run arbitrary software which comprises of operating systems and applications. The consumer can process, store, access networks and other computing resources. In this, the consumer is unable to manage or control the underlying cloud infrastructure but can control operating systems, storage, deployed applications and a limited set of networking components like host firewalls (Peter Mell, 2011). The cloud vendors allow the consumer to access a large number of compute instances fairly easily through the infrastructure services (R.Kannadasan, 2018). The advancement of technology in computing and storage devices has made IaaS as the pillar of cloud computing architecture. It is a platform that enables the providers to construct Software-as a Service and Platform as a Service layer. There are different IaaS solutions for different organisations and hence one solution does not fit all. It is the foundation layer for the different delivery models (Hossain, 2013).

The different components of IaaS are as follows:

- Physical and Virtual Servers
- Network Attached Storage (NAS) and Storage Area Network (SAN)
- Network blocks and Virtual local area networks for network segmentation
- Routers, firewalls and load balancer for communication network
- High speed internet connectivity
- Platform virtualisation environment
- Service-level agreements
- Utility computing billing
- Security like firewall and intrusion detection & prevention system
- Load Balancer for hardware
- Management and support services like Domain Name Service (DNS), Dynamic Host Configuration Protocol (DHCP) and other such services.
- Power, cooling and disaster recovery system (John W. Rittinghouse, 2009).

An example of IaaS is Amazon EC2 where the virtual servers are set up and configured over the web in a short span of time. The consumer has greater control over the hardware as compared to a Platform-as-a-Service as the consumer can choose the operating system, database and the application development environment based on the requirements. Thus, it enables the users to configure the servers based on their needs giving more options but also some level of maintenance when compared to Platform-as-a-Service (Hamrén, 2012).

Platform as a Service (PaaS)

The cloud service provider allows the consumer to create applications through development language in a PaaS. PaaS allows the consumer the flexibility and authority to create and modify applications in comparison to SaaS where the application already exists. PaaS thus is an extension of the SaaS application delivery model (John W. Rittinghouse, 2009). The consumer can thus create and run applications on the service provider's specific environment in the PaaS delivery model. This model provides the user with a complete operational and development environment to deploy the applications. The consumer can thus program using the vendor's specific application development platform for example the Google Apps Engine (Reese, 2009). The developer is provided with tools like programming languages and Application Programming Interfaces (API). As compared to IaaS, the user has no control over the virtualisation instance or network configuration of the cloud server (Peter Mell, 2011).

The user is provided with secure storage and confidentiality of the data by leveraging the tamper-proof capabilities of cryptographic co-processors. This service provides a secure execution domain which is physically and logically protected from unauthorised access. The infrastructure is such that it maximises the user's control over managing the data thus providing the privacy of sensitive information. This level of privacy is provided by implementing user-configurable software protection and data privacy mechanisms. The PaaS services includes a privacy feedback process. The user is also notified with different privacy operations that are applied on their data. PaaS makes the consumer aware of any potential data protection risk that may harm the confidentiality of their sensitive data (Qian Wang, 2009).

Software as a Service (SaaS)

The service provider allows the consumer to use the applications that are running on the cloud infrastructure. The web-based server allows the client to access the applications through a thin client interface like web email. Consumers cannot manage the cloud infrastructure like network, servers, operating systems, storage or even individual application capabilities. There could be possible exceptions of limited user preferred applications with configuration settings (Peter Mell, 2011).

A few of the characteristics of the SaaS model are as follows:

- The vendor takes the burden of getting and keeping the enterprise application running even after the consumer loses some level of control over the application. The user can access the software functionality without deploying or managing the software by themselves. It means that the SaaS applications are run on web browser through web-based interface thus also allowing scalability to add new users whenever required.
- The SaaS service is a 'pay-as-you-use' model of service where instead of licensing, installing or maintaining the software; the consumer can access the application through the internet.
- The total costs of using the application can be shared with other consumers by giving access to the software (multi-tenancy). This leads to economies of scale where the operational cost gets shared with multiple users. The user could also have control over the security by just deciding to be a single tenant of the application.
- The SaaS models enables a systematic support to the software for maintenance and upload of fixes and patches; rather than getting it done annually.

- The consumers are allowed to benefit with the latest features of the SaaS models without any additional cost associated with the updates and upgrades of the software.
- The SaaS model enables the user to eliminate any additional cost of additional support staff resources related to maintaining the complexities of software or hardware (Gene Newton, 2011).

The traditional method involved the user to purchase the software and locally install an application on their computer system. The user would then have to use a license key to authorise the usage of the software. The SaaS delivery model allows the user to pay for the software on a subscription level without letting to install it on the device. The software is thus accessed through the internet via web browser. For example, Google Docs allows the user to use word document, edit and store them online. The word document can be edited by multiple users and they can also use all the features of the application. The way SaaS is different from IaaS or PaaS is that the user cannot make changes to the application or the hardware on which it runs or on any network configurations. For example, Google provides the platform or the application Google Docs where the consumer uses it buy cannot directly alter it (Hamrén, 2012).

Technology Acceptance Model

The focus of the study is to encourage the acceptance of online cloud computing services amongst the students in the education system and also to recommend ways to improve the learning levels in the institutions. The actual usage of cloud computing services is a dependent variable. The theoretical framework that will be used in this research is Technology Acceptance Model which was developed by (Davis, 1989). It was developed to analyse a potential user's attitude towards acceptance or resistance to technology. The

research is based on six constructs such as Perceived Usefulness, Perceived Ease of Use, Cloud Computing Awareness and Risk and Security, Computer Self-efficacy and E-Skills.

Perceived Usefulness

Perceived Usefulness (PU) is defined as 'the degree to which a person believes that using a particular system would enhance his or her job performance' (Davis, 1989). This means that a higher perceived usefulness of cloud computing services would mean that there is a higher possibility of the consumer to be easily driven to the actual adoption and acceptance of cloud computing technology. (Kim, 2014) defined Perceived Usefulness as 'the degree to which users believe that using mobile cloud services improves their job performance and predicts that it will have similar positive effects on attitude toward and intention to use mobile cloud services.' So as per the research, Perceived Usefulness for college and university students would mean that the usage, acceptance and adoption of online cloud computing services would improve and enhance the academic performance of students. This would eventually result in better academic achievements. The cloud computing services would be better in terms of usage, understandability and reliability when compared to the conventional method of education. Perceived Usefulness in terms of the cloud computing infrastructure would also mean that data can be stored or uploaded or shared in local computer or local server thus eventually having positive effects on acceptance and adoption of cloud computing services in the education system (Sujeet Kumar Sharmaa, 2016).

Perceived Usefulness is considered as one of the most significant and dominant factors to influence the adoption of cloud computing applications. The adoption to cloud computing infrastructure includes features like low cost, accessibility, IT resources, flexibility, reliability and pay-as-you-use mechanism in addition to the convenience in location, time or

device as long as the user is connected to the internet. Thus, due to this perceived usefulness in online cloud computing platforms, students could find it easier and convenient to get their jobs done efficiently with increase in productivity. The rationale behind including Perceived Usefulness as one of the constructs is that the research is based on the student's perception on the usefulness of using, accepting and adapting to the cloud computing environment. It deals with the perception of students being able to exchange and share data & information in their academics inside or outside the universities using cloud applications like Dropbox, Google Drive, Microsoft OneDrive that leverage the conventional classroom educational methods and eventually improve the quality of academic performance and productivity (Sujeet Kumar Sharmaa, 2016). (Davis, 1989) emphasised that Perceived Usefulness had more impact on the adoption of application of a new technology than perceived ease of use. Furthermore, when university and college students feel that the cloud computing services and applications are useful in their day-to-day academic tasks, it would influence their attitude to use the services thus creating a positive impact on the education system enhancing the productivity and performance of students. Thus, the null hypothesis proposed is:

H1: Perceived Usefulness has no impact on cloud computing usage.

Perceived Ease of Use

Perceived Ease of Use is defined as 'the degree to which a person believes that using a particular system would be free of effort' by (Davis, 1989). He also clearly added that Perceived Ease of Use has the word 'ease' which means 'freedom from difficulty or great effort'. The model means that using any innovative system should make the user free from worries, difficulties or any extra effort to achieve the perceived performance. Moreover, attitude of a user is influenced by how easily the technology or innovation is perceived. Thus,

based on this theory, the research focuses on the Perceived Ease of Use as the degree to which the acceptance and adoption of the online cloud computing services is believed to be easy or free from any worries, difficulties and effortless to achieve better performance by the students. Also based on previous literature, the relationship between the perceived ease of use and the attitude towards accepting a new technology has resulted in positive and significant result (Xuebing Dong, 2017).

Thus, Technology Acceptance Model clearly mentions that the Perceived Ease of Use of any technology significantly influences and impacts directly the factor of Perceived Usefulness because the easier any technology is to use, the more useful the consumer will desire to use it (Venkatesh, 2000). (Changchit, 2014) states that the if the perceived ease of use is high for the user, the consumer will accept the cloud computing services because there would be less efforts to learn to use the services. Thus, the perceived ease of use helps in cooperation and readiness to the performance of the work of an individual. Thus, the null hypothesis proposed is:

H2: Perceived Ease of Use has no impact on cloud computing usage.

Cloud Computing Awareness

The research findings will decide how much awareness has been provided by institutions about the online cloud computing platforms to students in colleges and universities. Hence, cloud computing awareness amongst students is important. The research paper will also analyse if the cloud computing service providers need recommendations and innovative ideas to enhance their services to increase the acceptance and adoption of cloud computing infrastructure (Mahlindayu Tarmidi, 2014). Resources play a key factor in the

awareness of cloud computing services. So, if students are to be made aware of the benefits of the cloud computing services and adapt to the usage of online platforms, there has to be an increase in the resources provided by institutions. (Tero Pikkarainen, 2004) in one of the study focuses on the importance of the amount of online information provided to the consumers that plays as a key factor for the awareness of internet-based infrastructure. Lack of awareness is the main determinant that leads to the consumer to not adopt and accept a new technology (Sathye, 1999). Thus, the null hypothesis proposed is:

H3: Cloud Computing Awareness has no impact on cloud computing usage.

Risk and Security

One of the factors that influence the adoption and acceptance to the online cloud computing infrastructure are the privacy risks and security concerns of using the software services (Fa-Chang Cheng, 2012). According to (Paul Ambrose, 2010), privacy concerns is defined as 'the degree to which an individual believes that using a particular system would be a threat to his or her privacy'. But in the academic settings, students of different schools, colleges and universities feel secured to use the online cloud computing platforms for educational purposes because they think the institutions do not use any unsafe services. If students feel safe and secure to store and transfer data through the online platforms, they would willingly try to accept the cloud computing services (Changchit, 2014). Cloud computing service providers may still face a few challenges in terms of security. It may be due to negligence from the providers or any other software and hardware issues. Hence, privacy risk may be considered as an important factor leading to the acceptance of a new technology model (Ratten, 2014). Thus, students need to feel secured that no sensitive information

would be shared or leaked online while using cloud computing services for academia purposes. Thus, the null hypothesis proposed is:

H4: Risk and Security has no impact on cloud computing usage.

Computer Self-Efficacy

Another variable that can impact the adoption and acceptance of cloud computing infrastructure is computer self-efficacy. This variable can impact the participants behavioural aim to utilise the services provided by cloud computing infrastructure. Self-efficacy refers to the consumers' confidence and ability to use a specific source and requires capabilities to commit to the success of a task. Consumers behaviour are influenced by self-efficacy trait and they feel motivated to accept the technology (Bandura, 1977). Thus, in an academia setting students need to believe confident in their educational performance in order to find the online cloud computing platform useful and easy to use. Thus, the null hypothesis proposed is:

H5: Computer Self-Efficacy has no impact on cloud computing usage.

E-Skills

Internet skills influence the usage of internet in the modern age. This creates a clear difference in different people accepting and using the internet to their advantage (Alexander J.A.M. van Deursen, 2009). Also, this study clearly mentioned that consumers have to possess technical and substantial internet skills in order to adopt the online infrastructure. E-skills would thus impact on the method of learning by students. Students should learn and accept new methodologies that could impact the process of learning. Therefore, a significant

consideration has been made to e-skills in the research (Adel Ben Youssef, 2008). Thus, the null hypothesis proposed is:

H6: E-Skills has no impact on cloud computing usage.

Cloud Computing and Universities

Knowledge plays the most important and basic resource of information in the society that helps shape the future of an individual. In the age of innovation, where information gains a very strategic value in its own right, there are still societies that are unable to access, use, manage and benefit from the power of knowledge. The level of knowledge needs to be mobilized amongst these low levels in the industrial society. The most of the power of the information technology are dominated by developed countries which are usually characterised as information societies. The gap between the countries is increasing because nations that make the most of the IT industry are becoming stronger and dominant whereas the nations that lack the investment and planning of IT infrastructure are becoming economically poor (Candan, 2016). But there has been an increase in the diversification of information produced, stored and shared through electronic devices leading to access to the information independent of location or time.

It is significant that as long as there would be advancement in the IT industry, the production and presentation of information services will keep continuing. With the rapid increase in the computer and internet use in all the segments of the society and the access to information for users from any location possible, there has been a transition in the communication environment leading to higher expectations of the user (Donald G. Frank, 1999). Universities play a very important determinant in the information society. The

universities could help improve the level of technical and scientific knowledge and train personnel as required by the society. Universities and colleges increase the intellectual power and culture of students. Institutions play a key role in raising the standard and culture of the society in which they serve (Cakin, 2004).

There is a big challenge for universities while delivering information services to the students. A few of the common challenges include budget cost, licensing problems and management of software & hardware. Cloud computing thus plays an important role to overcome these challenges in an effective and cost-efficient manner. Cloud computing provides some benefits like elasticity, measurability, accessibility and standardisation of the information applications to the universities. However, challenges in terms of security, compliance issues, reliability, lack of skills, insufficient support provided by the cloud providers or even policy concerns are experienced while adapting to a cloud environment in the education society (K Njenga, 2019). A few of the cloud applications that are extensively used are Google Apps, Dropbox, Google Apps for Education, Microsoft Office 365. Universities should not just consider the benefits of cloud computing infrastructure but also be willing to invest their finances effectively and efficiently. There needs to be an effective IT governance for educational institutions. There could be a stage where the classic University understanding could be eliminated if university commit to a complete adoption to cloud computing environment (Isaias Scalabrin Bianchi, 2016).

Transition To Cloud Environment

The transition from the existing traditional IT system to cloud platforms is difficult and costly. There are different methods of transition to the cloud infrastructure in literature. A few studies indicate that the transition to cloud environment includes evaluation, design,

establishment, implementation and operation of cloud technologies and applications. There are others who suggest that the transition includes steps like organisational evaluation, design, pilot cloud implementation, cloud preparation assessment, cloud dissemination strategy and continuous cloud improvement strategy (Wyld, 2009). As per (Takai, 2012), the transition methods include the following steps: promoting the cloud infrastructure, consolidating data centre, establishment of enterprise cloud infrastructure and submission of cloud services. It basically includes a five-step framework such as confirmation, implementation, decision, knowledge and persuasion. There are different online platforms that allow faculty and students to upload, view, download lectures, assignments and a lot more over any preferred device from anywhere over the internet (Takai, 2012).

ICT Environment in The Education System in Ireland

In the 1970s, there was a trend that the teachers from the mathematics discipline would be given the authority to understand and teach the key functions and operations of the computer and programming skills. Thus, the early days of the computer usage was well dominated by the teachers of the mathematics discipline (McGarr, 2009). This trend changed in the 1980s where the Irish schools started considering the common computer applications as a stand-alone subject for students. These subjects focused on upskilling the learner on computer applications like work processing software. Later in the year 1997, the Department for Education and Science in Dublin noted that 'Ireland was facing challenges in coping with the level of integration of information and communication technologies into the education system as compared to its European partners'. Thus, it was essential for the Education department to address this rising concern in order to meet Ireland's future economic well-being. The Department of Education then launched the 'Schools IT 2000' initiative in the year

1997 to integrate the process of ICT learning within the education system in Ireland. The aim of the 'Schools IT 2000' policy was to increase the IT infrastructure by adapting to technology enabled classroom resources and also to improve the ICT skills of the educator who would eventually provide support for ICT integration in schools (Department of Education and Science, 1997). The National Centre for Technology in Education (NCTE) was setup in the year 1998 to achieve the integration of ICT in the education system in the primary and post-primary levels. The NCTE provided the required support and training to students in schools thus helping in integrating technology infrastructure in the education system (Department of Education and Science , 2008). In the year 2001, the Department of Education and Science released a document called 'Blueprint for the Future of ICTs (2001-2003)'. The main objective of this policy was to expand the ICT infrastructure in schools and colleges, improved access to the internet, adoption and integration of ICT learning and the improvement of professional development for teachers in the education system (Department of Education and Science, 2001). But later in 2014, a statement by (Johnston, 2014) clearly criticised the formation of 'Schools IT 2000' mentioning 'the lack of underpinning philosophy and clarity regarding educational purpose'. He also mentioned that the structure was also negatively impacted due to the Irish political and other external factors in addition to a 'techno-centric/innovation focused discourse' that continued through the 'Blueprint for the Future of ICT's' programme.

The Government of Ireland (GOI) in the year 2007 mentioned that it would allocate just over quarter a billion euros to the ICT integration in schools from 2007 to 2013 in its National Development Plan. This policy would promote ICT enable learning in schools and colleges in Ireland (Government of Ireland, 2007). In 2008, a report called the 'ICT in Schools: Inspectorate Evaluation Studies' was generated which collected data from schools and colleges. The range of sources included a national survey by principals and teachers and

questionnaire completed by students presenting an analysis of the availability of ICT in schools and colleges. The main recommendations from the data analysis were to highlight the focus on enhancing the existing ICT infrastructure and enable advanced training for teachers by improving the ICT learning capacity (Department of Education and Science , 2008). Later that year, Mary Hannifin, the Irish Minister of Education and Science established a strategy group stated in the National Development Plan to prioritise on investing in ICT integration in schools. This resulted in the report called 'Investing Effectively in Information and Communications Technology in Schools, 2008-2013: The Report of Ministers' Strategy Group'. (Department of Education and Science , 2008). This report emphasised on seven key objectives which included: continuing professional development, software and digital content for students and educators, ICT enable equipment, broadband and internet services for schools, ICT technical support and maintenance resources, implementation structures and support and future innovative practices & research. There was also a strategy to have 5:1 pupil to computer ratio and classrooms to be equipped with digital projectors, fixed computers with network & broadband enabled. It also mentioned that a major percentage of the funding (281 million euros) to be allocated to ICT infrastructure, equipment and software. However, only 49 million euros to be allocated for CPD training and ICT education advisory services and approximately 7 million euros for innovative practise and research (Department of Education and Science , 2008).

In 2009, the Department of Education and Science published the 'Smart Schools = Smart Economy' report. According to this report, primary and secondary schools were provided support to enhance their integration of ICT infrastructure. This would mean enabling support for improvement in 'Classroom and student infrastructure, technical support and virtual learning environment (VLE), Teacher Professional Development, ICT planning and

multi-annual budgeting, Digital content growth and Enhancement broadband for schools' (Department of Education and Science, 2009). However, due to the impact of economic recession in the year 2008, the key support towards the meaningful integration of ICT in education was condensed.

The signs of recovery in the Irish economy enable some advancement of the adoption of ICT infrastructure in 2014. This was backed up with the articulation of a new curriculum framework called the Framework for Junior Cycle for the post-primary students. There was addition of three more policies namely the ICT Skills Action Plan 2014-2018, The Action Plan for Education 2016-2019 and the Digital Strategy for Schools 2015-2020 (Department of Education and Science, 2015) (Department of Education and Science, 2016). The Framework for Junior Cycle 2015 focused on improving teaching, learning and assessment practices supporting the delivery of quality ICT education for students in the first 3 years of post-primary education. This framework emphasised on strengthening the diversity of teaching approaches and assessment. It would enable educators to highlight on digital skills development amongst the students (Department of Education and Science, 2015). In order to support the long-term economic development in Ireland, the 'ICT Skills Action Plan 2014-2018' was created by the Department of Education and Skills collaborating with the Department of Jobs, Enterprise and Innovation Industry. This policy was implemented in partnership with the state agencies and other major IT industry stakeholders to improve the ICT skills of learners of all ages in colleges and universities. The ICT Skills Action Plan included actions like improvement of school infrastructure, teacher professional development and re-development of curriculum to name a few (Department of Education and Skills (DES) & Department of Jobs, Enterprise & Innovation (DJEI),, 2014). A strategic overview of the ICT education and training reform programme was mentioned in the 'Action Plan for Education

2016-2019' developed by the Department of Education and Skills. The main objectives of this action plan were: improve learning experience and success of learners, improve the progress of learners at risk of educational disadvantage or learners with special educational needs, help those delivering education services to continuously improve, build stronger bridges between education and the wider community and improve national planning and support services (Department of Education and Science, 2016). The 'Digital Strategy for Schools 2015-2020' was a five-year digital strategy to enhance and improve the use of ICT in teaching, learning and assessment within primary and secondary schools and colleges. The main aims of this plan were: Teaching, learning and assessment using ICT, teacher professional learning, leadership, research and policy, and ICT Infrastructure. These aims were focused on providing financial resourcing and training to the educators in order to bring a positive change in the ICT infrastructure in the education system in Ireland (Department of Education and Science, 2015).

The schools, colleges and universities in Ireland have some similarities now in terms of management, finance and training structure in how they deal with ICT infrastructure. A basic analysis of the ICT structure of the education system in Ireland contains the following groups:

- Network/System: This is usually handled or controlled by the cloud computing or IT service provider and it contains technical works like network installation and computer maintenance. It also contains the system management unit, technical support and operating services and other information.
- Software or Web Projects: This unit includes Web technologies and services, Web Management Unit and Web Design.

- Administrative Financial Unit: This would contain the financial affairs of the ICT infrastructure, administrative works and offices.
- Help Desk: This unit is where the consumer would contact the service provider when facing any hardware or software issues. It contains the project support group, user support unit and hardware & software support team.
- Project and Personnel Management: This unit comprises of the E-document and Personnel coordination unit, process & governance group and analysis & training branch (M Damar, 2017).

From the literature review it is clear that there is a gap in knowledge of understanding the influence of adoption of cloud computing infrastructure amongst the students in Dublin. Although various policies have adopted in the past to enhance the ICT infrastructure in the education system in Ireland, no study has been made to understand the factors that students believe influence the usage of cloud computing platforms and analyse the degree of influence of the acceptance of e-learning environment in the education system. This research is thus focussed on analysing various constructs of the Technology Acceptance Model that could serve as key factors that encourage students to accept or reject the new and innovative technology of online learning based on cloud computing applications.

Methodology

The methodology explains the methods that the research uses to analyse the various constructs influencing the adoption of cloud-based learning in the education system. It also discusses the tools that are used to measure the variables and the explain the reasons behind choosing the appropriate audience for this research. The selection of students in the undergraduate and post graduate degree is justified and the variables that formed the theme for the questionnaire has been put forward.

Participants

The population in the research are the students undertaking under-graduate and post-graduate education of public and private colleges and universities in Dublin. Primary data will be collected from students studying in major universities in Dublin such as Trinity College Dublin, University College Dublin, Technological University Dublin, Dublin City University and also a few colleges like Dublin Business School and Griffith College. The research took into account the variety of respondents from the colleges and universities mentioned before and also having a different geographical location. The students that participated in the questionnaire also covered different groups of the community with different cultural background, perception and ethnicity. The students pursuing the post-graduate study in Dublin had not necessarily possessed an undergraduate degree in Ireland which made it different in the perception of using online learning platforms and their adoption. The sample represented college and university students thus resembling a mix of race, culture, language and beliefs of the individuals (Cooper, 1980). These cultural differences and background of previous level of education are more likely to influence the perception, attitudes and behavior of accepting online learning cloud computing applications for academic purpose. Thus, this

difference influences the different ways in which the students think and act towards the new technology and accordingly helps decide the acceptance or rejection to the cloud computing infrastructure in the education system. Also, the respondents from different colleges and universities offer an appropriate mix to the phenomenon that would be analyzed as it would provide some idea towards difference in the culture impacting the different opinions and attitude towards a behavior; which in this case is acceptance of the cloud computing infrastructure in the educational environment (YoonmoSang, 2015). In order words, an analysis from this research would likely provide a wider view of the age group of the students and the electronic devices that they require for to use the online cloud applications for educational purpose. Also, the participants have an option of choosing the type of course they are enrolled into which is either part-time or full time thus influencing the usage of online platforms and providing feedback to the researcher on the behavior of acceptance to the cloud software. The time horizon for this project is cross-sectional as students were surveyed during a period of April and May 2022. Thus, educational institutions could focus on factors that could influence the acceptance and adoption to the cloud computing infrastructure on the educational system in Dublin.

Research Design

Since there was a gap in knowledge to the adoption of cloud computing technology in the educational institutions in Dublin, this research seeks to examine and analyse the factors that impact the acceptance of online cloud computing environment by the under graduate and post graduate students in Dublin. Therefore, this research is descriptive as it aims to describe characteristics that would lead to the adoption of the cloud computing technologies with the student population of Dublin. Therefore, since the theory about the issue is well

defined quantitative approach has been used in this study consisting of gathering data with a structured questionnaire from the students. The questionnaire was divided into independent variables like demographics (age, sex, nationality etc) and dependent variables like perceived usefulness, perceived ease of use, cloud computing awareness, risk & security, computer self-efficacy and e-skills. These structure questionnaires would then be analysed statistically.

Materials

In this research, the data was collected individually through survey that was conducted over a span of over one month period between April and May 2022. The data was collected by distributing Google Forms via email to the students. The survey was based on questions related to the adoption of the online cloud computing applications like Google Drive, Dropbox or Microsoft OneDrive and other online applications & services in the educational system. The first section was based on demographics having questions related to age, sex, nationality, course type and the type of devices used to access the online platforms. Then the questionnaire was divided into six constructs such as perceived usefulness, perceived ease of use, cloud computing awareness, risk & security, computer self-efficacy and e-skills which would set the base for the research. These six constructs serve as the key factors that would influence the adoption of cloud computing services by students in the academic background. The items on these questions were measured in a five-point Likert scale form with a range of (1) strongly disagree to (5) strongly agree. The data was collected from approximately 100 students in Dublin who are studying in colleges and universities. Moreover, the sample included students of two levels of education i.e., under graduate and post graduate degree. The target was to consider as many institutions to offer a variety in the answers leading to the analysis of the research.

The following table gives an explanation of the independent variables:

Variable	Definition	Measure
Perceived Usefulness	It is defined as a "degree to which an individual believes that using a particular system would enhance his or her job performance.	Ordinal Variable: 1 = Strongly Disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly Agree
Perceived Ease of Use	It is defined as a level at which the user expects that the technology to be easy to use.	Ordinal Variable: 1 = Strongly Disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly Agree
Cloud Computing Awareness	Cloud Computing Awareness defines the practical knowledge to the cloud computing providers on the technical awareness of students using this platform for their education.	Ordinal Variable: 1 = Strongly Disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly Agree
Risk and Security	Privacy and Security were two main concerns in relation to the adoption of cloud computing services in the education system. The more secure the cloud services are, more students would feel safe to use these services. Students can then start accepting this technology.	Ordinal Variable: 1 = Strongly Disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly Agree
Computer Self-Efficacy	Self-Efficacy means that an individual is confident that he/she has authority to the source and has capabilities to commit and achieve success in the specific task	Ordinal Variable: 1 = Strongly Disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly Agree
E-Skills	Another important variable that needs to be considered for the students are the internet skills. E-skills impact the students' process of learning and could then offer new methodologies of learning.	Ordinal Variable: 1 = Strongly Disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly Agree

The set of questions that were used for the research are attached in the Appendix as title 'Questionnaire'.

Ethics

The data collection will not involve any vulnerable group of people. It will include students studying under graduate and post graduate education in Dublin. The questionnaire will be based on demographics like age, sex, type of course they are studying and hence will not include any personal information been asked or shared. The project is based on questions been asked to student about their usage in cloud computing applications. A consent form will be provided before they would start answering the questions. Information about the project like aims and impact of the research to the education system will be included and how the privacy of the data will be maintained will be provided to the respondents. Since the research questions to be answered are voluntary, students can opt to not attend the questionnaires as per their consent. Participants can withdraw from the survey at any given time without citing any reason whatsoever. Since the project is academic, hence questions will not include any personal information of any participants. Complete anonymity will be maintained throughout the data collection. The survey will be designed in Google Forms and no URLs or IP address tracking will be used. The responses will be stored online using a secure password protect space throughout the completion of the project. The research project is a quantitative type research where respondents are to answer questions that will carry no physical risk to them. The questions will only be related to their usage of cloud computing technology and the various impact of it in the education system. Participants can withdraw from the survey at any given time without citing any reason whatsoever. No conflict of interest has been identified in the project as questions will be based on age, sex, usage of device and various other constructs like usefulness and e-skills will be measured. Hence, this will maintain the integrity of the participants for the project.

The consent form used for the research is attached in the Appendix titled as “Consent Form and Information Sheet’.

Analysis

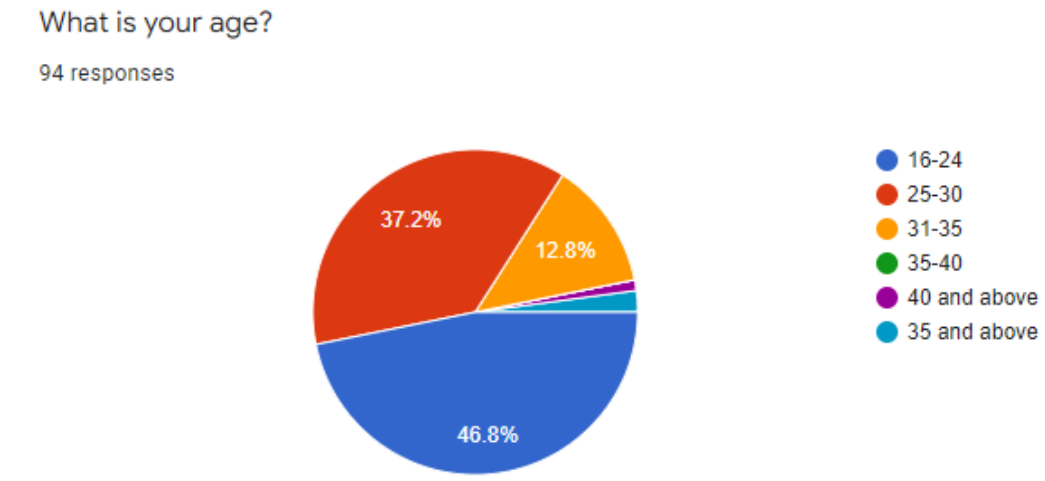
The main goal of this research is to evaluate the attitude of students related to the usage of cloud computing applications in the education system. It is also important to understand what factors influence the adoption and acceptance of online learning applications on the students of undergraduate and post graduate degree. These factors will act as a valuable predictor for using cloud computing applications for academic purpose and also to contribute in increasing the knowledge. For example, with the identification of these factors, educational institutions will be able to adjust and modify the processes of modern-day learning in schools and colleges.

Demographics

As mentioned earlier, the aim of this research was to analyze the adoption of online cloud computing applications on students studying undergraduate and postgraduate education in Dublin. Hence, a set of questions were sent to students across various universities and colleges in Dublin. 94 students responded to these questions. These students were from some of the major universities and colleges in Dublin viz. Trinity College Dublin, University College Dublin, Technological University Dublin, Dublin City University, Dublin Business School and Griffith College pursing a range of different courses.

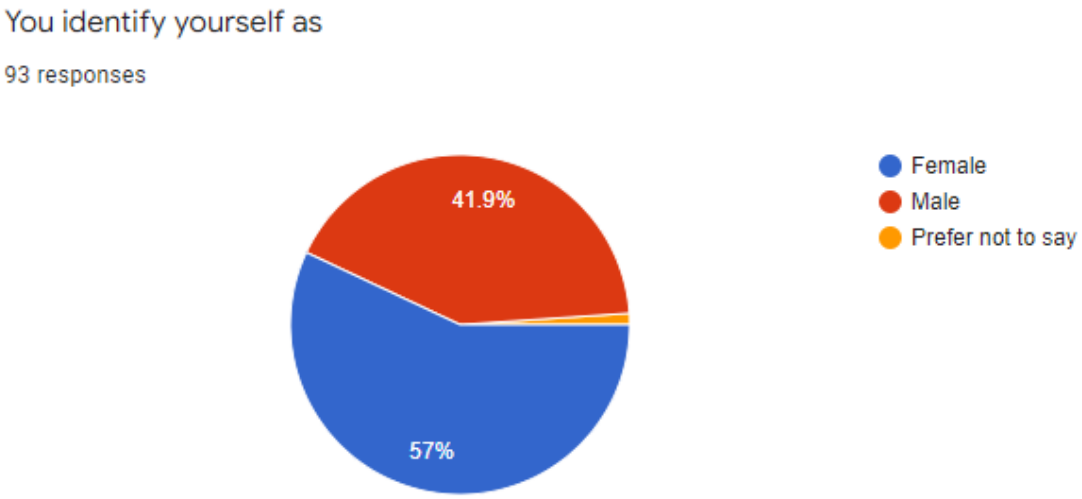
The questions and analysis based on Demographics are as follows:

Q1:



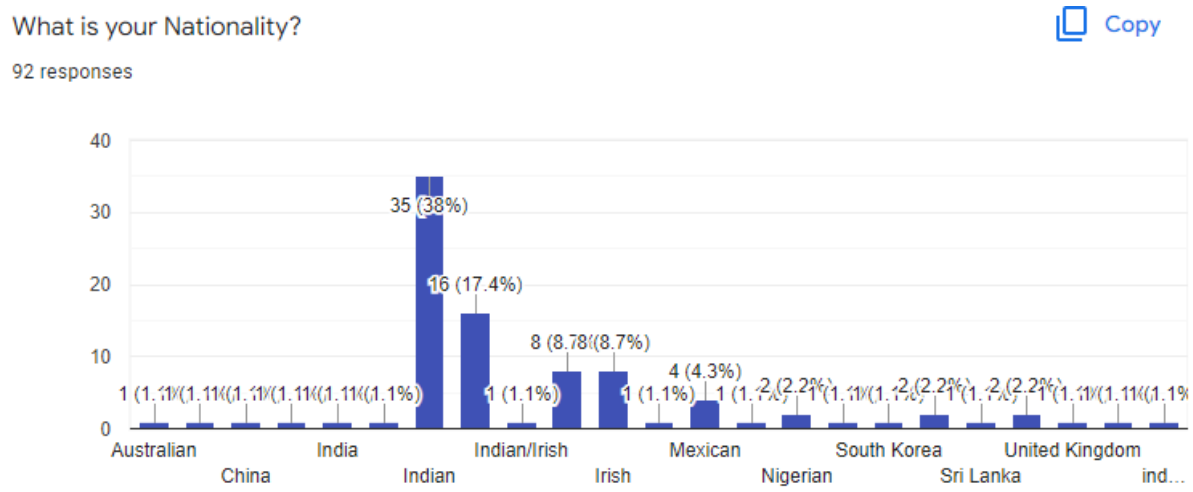
As per the above pie chart, the student population aged 16-24 were the majority with 46.8% followed by students of age 25-30 which around 37.2%. Around 12.8% students were between the age 31-35 followed by 3% for students aged 35 and above.

Q2:



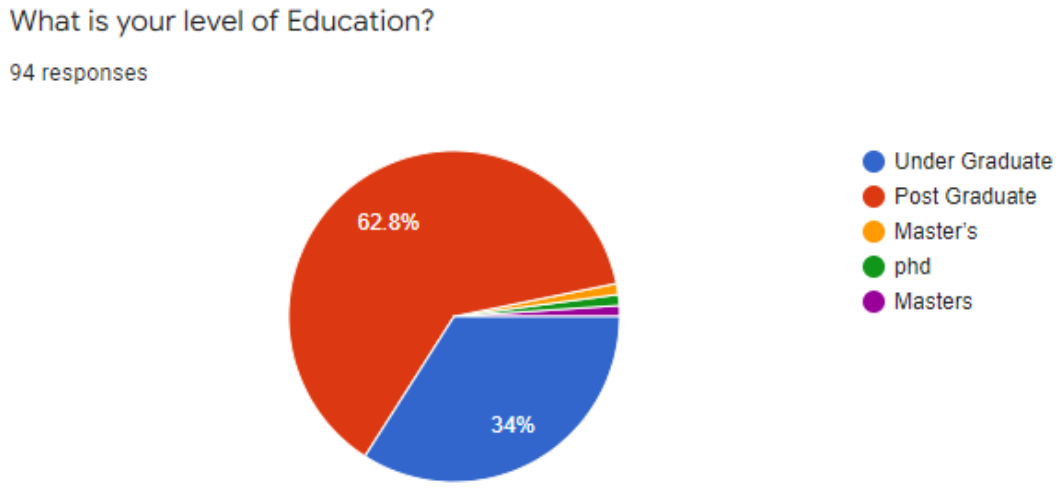
When asked about the gender of the students, most of the students were females. The results shows that 57% were females and around 42% of the participants were males. This leaves to understand that female participants using cloud computing applications are more than males using the services.

Q3:



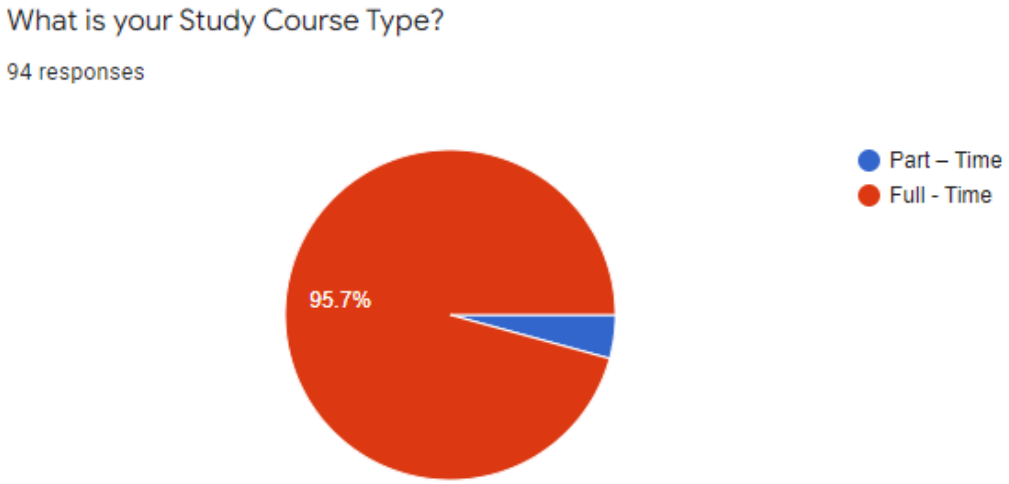
The research question also took into account the variety in nationality the students belonged to. This difference in the nationality covered different groups of the community with different cultural background. Most of the students seemed to be international students pursuing different level of education in Dublin. Out of the 92 responses, around half of the participants were Indian. The next majority of students were local Irish citizens undertaking undergraduate or post graduate education. These cultural differences and background of previous level of education are more likely to influence the attitudes and behavior of accepting online learning cloud computing applications for academic purpose.

Q4:



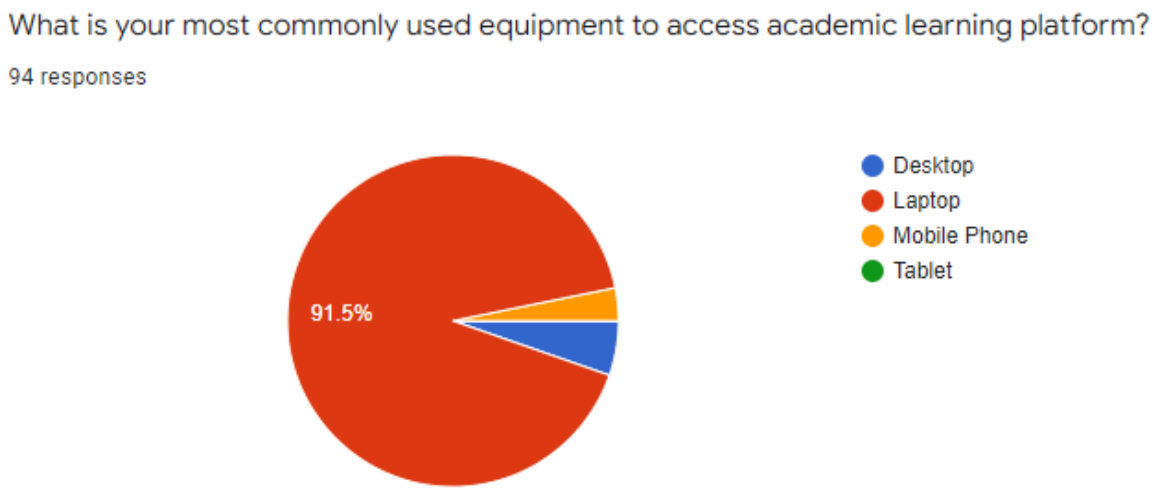
With regards to the level of the study, it can be observed that most of the students are pursuing post graduate education which is nearly 63%. The remaining students (around 30 numbers) were studying undergraduate level of education.

Q5:



Out of the 94 responses from students, 90 students were pursuing a full-time course. Only 4 students were pursuing part-time course. Since, the research aim was to analyze the acceptance of online education for students, it was necessary to find out the type of education the participants were undertaking.

Q6:



Since the research aim is to find out influence of online cloud applications on the academic environment, it was necessary to evaluate the devices that students find it convenient to access the online learning platforms. Students can check on the course module, complete assignments and tests, participate in online discussions. They not only can share data but launch collaborative sessions to work with the student groups. The cloud service providers create a specific platform for students to access the data. Various educational applications like Moodle also serves as a learning platform to allow students to view the course content, view grades, undergo discussions with the teachers and work as groups for assignments. Such applications are available both as desktop format and also on mobile applications. Hence, it was necessary to find out the type of devices student use to access these academic learning platforms (Arul Leena Rose. P. J, 2021). After evaluation, it was found out that 86 number of students preferred to use their personal laptops for educational purposes. About 3 students prefer mobile phone to access the online learning applications whereas about 5 participants use the desktop as a common device to access the cloud applications for educational purposes.

Perceived Usefulness

Perceived Usefulness is the factor that reflects that the user could enhance his or her performance using the technology. It is key factor to analyze the adoption of online learning applications amongst students in colleges and universities. It would mean that a higher degree of perceived usefulness amongst students would mean higher possibility of the students to be easily driven to the adoption of the cloud computing application.

The questions were based on efficiency of online learning to which 40.9% participants ‘agreed’ and 11.8% ‘strongly agreed’ that online learning makes things more efficient whereas

32.3% were ‘neutral’ about it. Clearly, 9.7% ‘disagreed’ and 5.4% ‘strongly disagreed’ to the fact that online learning would be efficient. When asked if cloud computing platforms like Google Drive, Dropbox or OneDrive makes storing data and information faster, about 39.8% participants ‘strongly agreed’ and 41.9% ‘agreed’ to it. Participants were also asked if cloud computing applications like Google Docs and OneDrive improved the quality of academic work. Around 39.8% ‘strongly agreed’ and 29% students ‘agreed’ that the quality of educational work is enhanced but 20.4% students were ‘neutral’ and 5.4% participants ‘disagreed’ to this question. 33.3% students ‘strongly agree’ that cloud computing platforms are very useful for academic purpose but 14% students are ‘neutral’ about it. 46.2% students ‘agree’ that online learning services offer more advantage over offline information techniques. 21.5% students are ‘neutral’ to this fact whereas 12.9% students prefer offline education techniques over the newly adapted online learning services.

A summary of the analysis of questions based on ‘Perceived Usefulness’ has been provided on the table below:

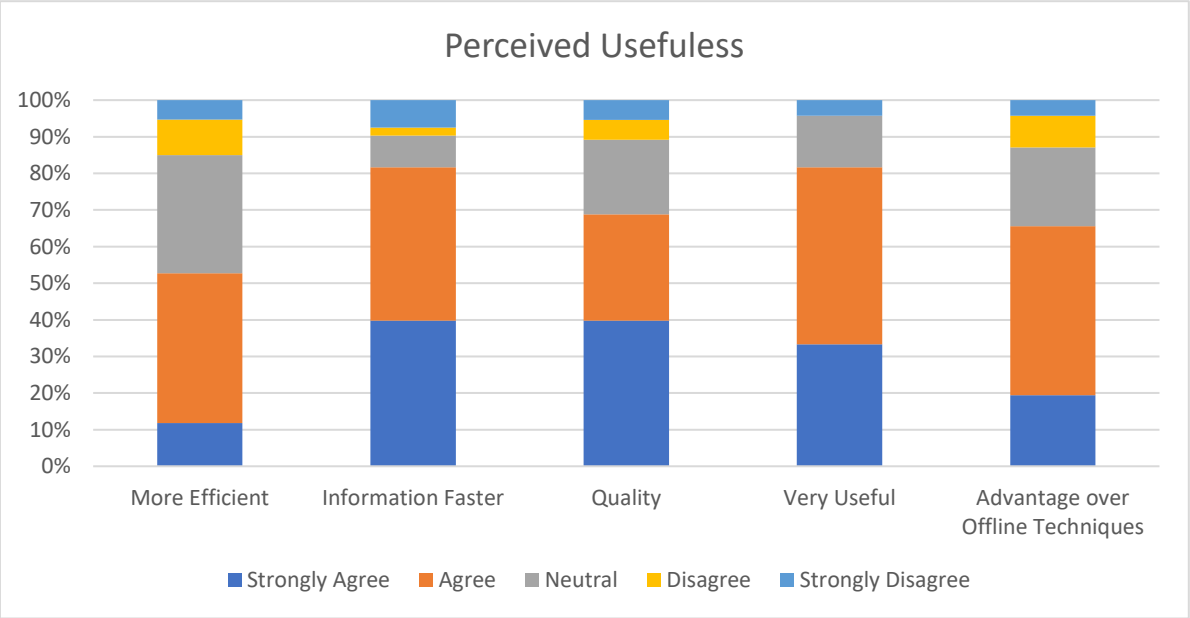


Table 1 Analysis of Questions based on Perceived Usefulness

This analysis gives a clear picture that online learning applications are more efficient as approximately 50% students have agreed to it. Also, around 80% students believe that online platforms make storing information and data faster. The quality of information shared improves through online services as 70% students agreed to it. About 80% students find these applications very useful and approximately 65% students choosing online education system over the offline educational techniques. Thus, alternative hypothesis is that perceived usefulness has impact on the usage of cloud computing applications.

Perceived Ease of Use

Perceived Ease of Use is a factor where the students believe that using the cloud computing application would make it effort free to achieve the performance. The questions were asked to identify if the students found it easy and effortless to use the cloud computing applications for educational purposes.

When asked to the participants if the online cloud computing e-learning platforms are easy to use for academic purposes, 64.5% participants ‘agreed’ and 15.1% ‘strongly agreed’ to it. About 48.4% students ‘agreed’ to the fact that online applications like Google Drive, Dropbox or Office 365 are easy to learn but 10.8% participants were ‘neutral’ about it. 36.6% students ‘strongly agreed’ that Interacting and sharing information in the cloud computing platform like Google Docs or Office 365 is clear and easy to understand. 21.5% students stated ‘neutral’ when asked the same about interacting and sharing information in the cloud computing platforms.

A summary of the analysis of questions based on 'Perceived Ease of Use' has been provided on the table below:

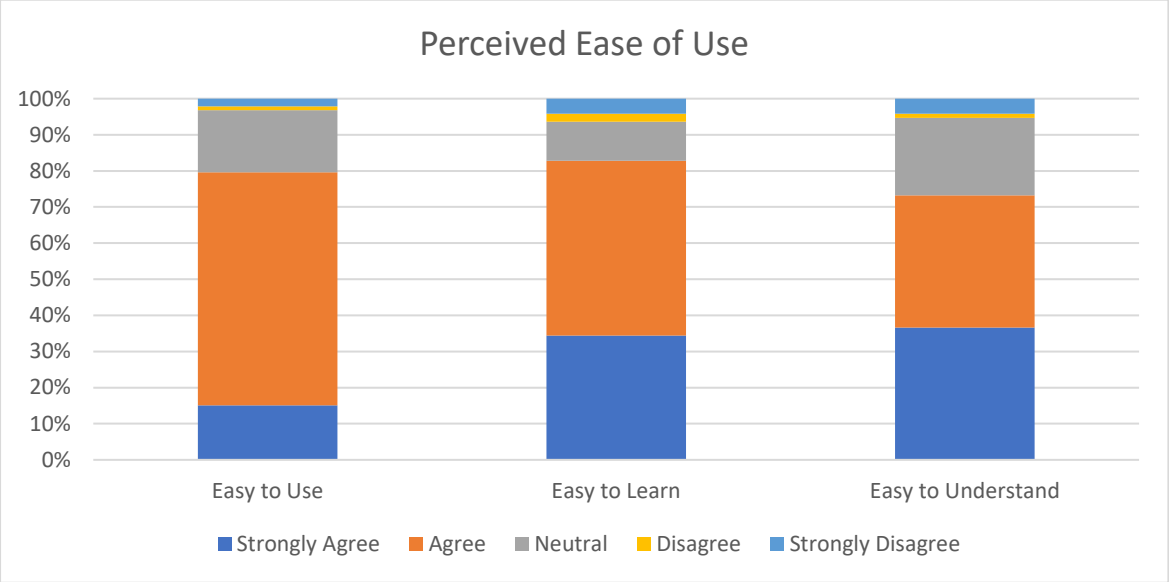


Table 2 Analysis of Questions based on Perceived Ease of Use

After analyzing the above table, it is obvious that online cloud learning applications are easy to use, learn and understand as approximately 80% of the candidates agree to it. Thus, if the technology seems easy for the participants to use it, the more useful the candidates will desire to use it. Thus, perceived ease of use helps to enhance the academic performance of the students. Also, alternative hypothesis is that perceived ease of use has impact on the usage of cloud computing applications.

Cloud Computing Awareness

Awareness related to cloud computing application and services must be provided by institutions handling online learning environment. This research aims to identify the factors that influence the cloud services and hence students were asked if they were made aware of the benefits of using online applications for educational purposes.

Based on the survey, about 47.8% students 'agreed' that enough information was provided by institutions about the cloud computing services. But when asked if students were made aware of the 'benefits' of the cloud computing applications, only 28% student population 'agreed' to it. Around 28% students had 'neutral' response to the benefits of the cloud applications provided by their institutions and 29% students clearly 'disagree' that they were not informed about the benefits of cloud computing services and applications.

A summary of the analysis of questions based on 'Cloud Computing Awareness' has been provided on the table below:

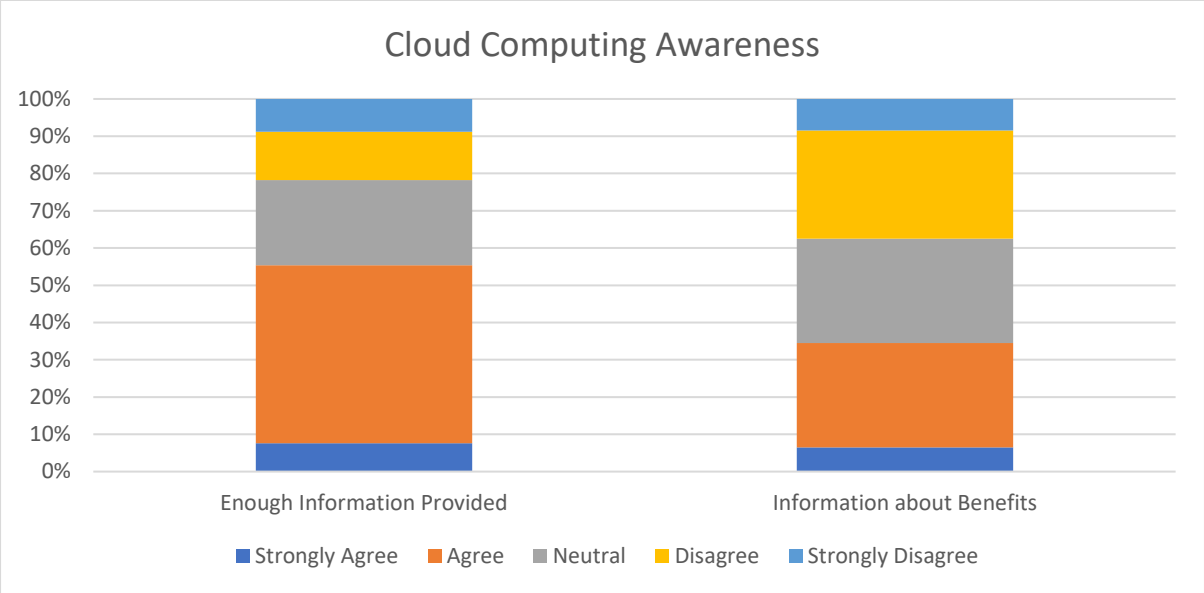


Table 3 Analysis of Questions based on Cloud Computing Awareness

The table above reflects that 30% students agreed to the fact that institutions provided enough information on the benefits of cloud computing but the other 30% stated 'neutral' responses. Clearly, approximately 30% students disagreed to the information provided by institutions on the benefits of cloud applications. This means that institutions need to provide the students with enough resources to allow students to be aware of the cloud computing environment adapted in the colleges and universities. Lack of awareness about the latest advancement on online learning could prove crucial for the adoption of

cloud-based learning environment. Thus, the alternative hypothesis is generated that cloud computing awareness has impact on the usage of cloud computing applications.

Risk and Security

Privacy concerns has always been a key factor when trying to adapt to a new technology. Hence, it was important to frame questions related to risk and security while using e-learning services provided by the institutions. Students need to feel safe and secure while using the online applications as there could be serious concerns related to breach in privacy.

22.6% students 'strongly agreed' and 52.7% students 'agreed' to the fact that they feel secure to use cloud computing platforms for educational purpose. 39.8% student population 'agreed' to the question that Cloud Computing e-learning services are safe to transfer data and other information amongst other fellow students. But, nearly 47.8% students answered 'neutral' when asked if they believed no sensitive information will be shared or leaked through online data sharing applications. This clearly states the uncertainty amongst students in relation to sensitive and personal information been shared.

A summary of the analysis of questions based on 'Risk and Security' has been provided on the table below:

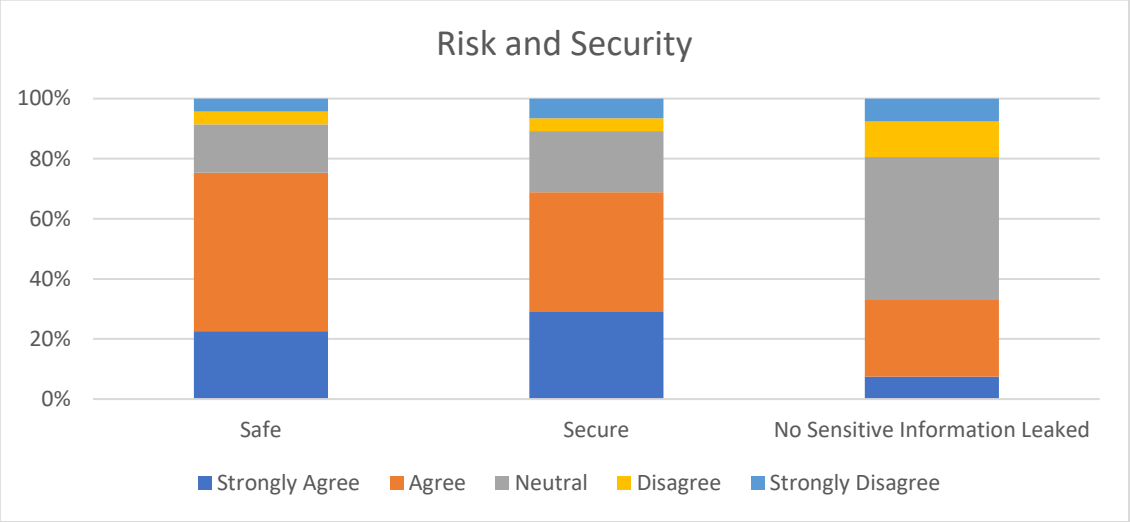


Table 4 Analysis of Questions based on Risk and Security

The table reflects that although 70% students feel safe and secure to use the online platforms for educational purposes, there are a certain percentage (50%) students who are neutral toward the privacy concerns about sensitive information being shared online. 20% students clearly disagree that sensitive information will not be shared online. Hence, it is a matter for concern for the educational institutions and the cloud computing service providers that students need to be assured that no sensitive information will be leaked while accessing online applications for educational purposes. Thus, alternative hypothesis that risk and security might have a negative impact on the usage of cloud computing applications.

Computer Self-Efficacy

Students need to be confident to use the online cloud computing platform for educational purposes. Hence, students were asked if they need help from any external sources while accessing the various online application in the academia setting.

Based on the questionnaire, 28% students 'strongly agreed' and 49.5% students 'agreed' that they do not need any external help to use the online services for educational purposes. It also mentions that 41.9% student 'disagree' that some help will be required to access the e-learning platforms in the colleges and universities. When asked if students require any user manual for using the online platforms, 17.2% 'strongly agreed', 37.6% 'agreed', 17.2% were neutral and 17.2% disagreed to the questions.

A summary of the analysis of questions based on 'Computer Self-efficacy' has been provided on the table below:

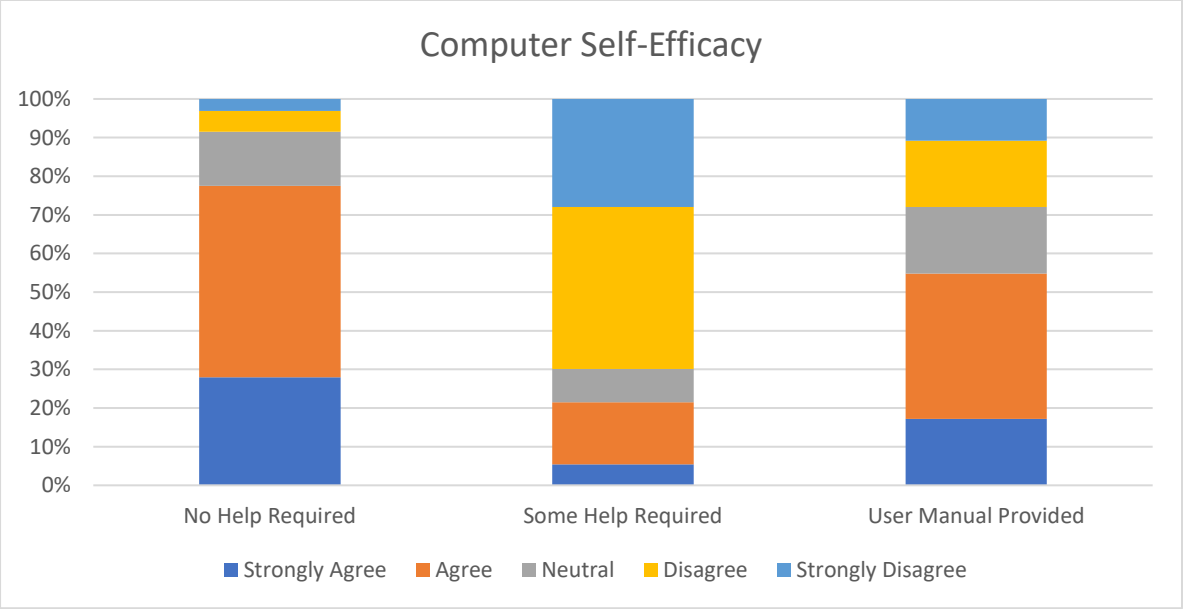


Table 5 Analysis of Questions based on Computer Self-Efficacy

The summary table reflects that 50% students would prefer to be assisted with user manuals to use the online learning application for academic setting. This would make them more confident to adapt to the cloud computing environment and could eventually enhance their academic performance. Hence, the alternative hypothesis is that cloud self-efficacy has impact on the usage of cloud computing applications.

E-Skills

Nowadays, students need to possess technical and substantial internet skills to accept and adapt to the usage of cloud computing applications. Hence, questions were based on learning and accepting the new methodologies of the cloud platform.

As per the survey, 33.3% students 'disagreed' and 9.7% 'strongly disagreed' that it is difficult to find the right keyword for educational purpose. But 31.2% students had 'neutral' response to the difficulty in finding the right keyword. When asked if students faced difficulties to find the relevant website while studying, 20.4% students had 'neutral' response and 46.2% students clearly disagreed to it. Sometimes it could be tiring to look for the information online and thus, 25.8% students 'agreed' to it. While doing a web search, 49.5% participants 'agreed' to have been distracted to a different website which was not intended to be used.

A summary of the analysis of questions based on 'E-Skills' has been provided on the table below:

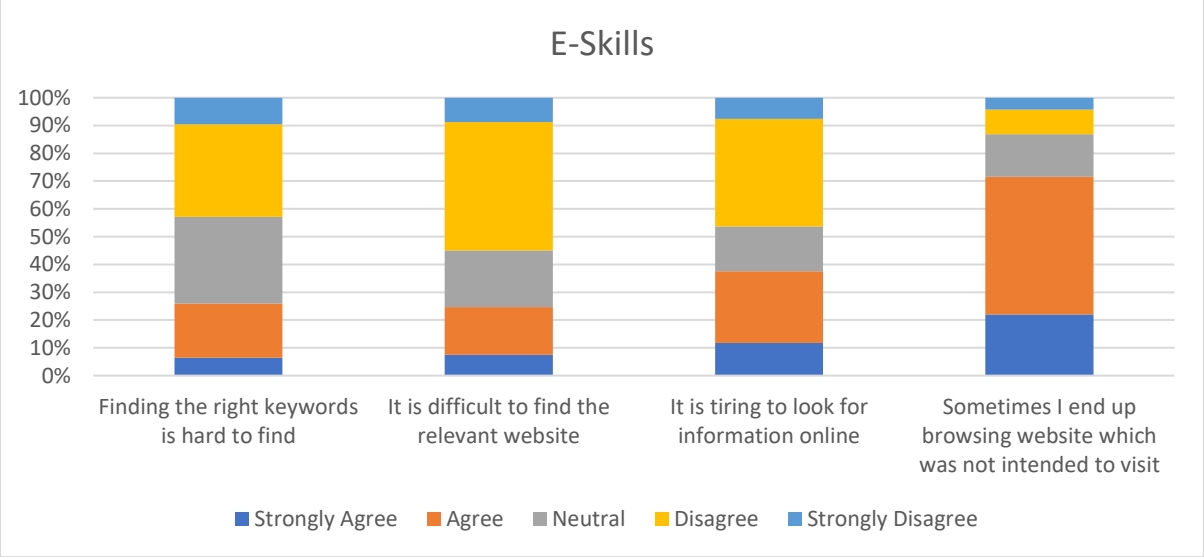


Table 6 Analysis of Questions based on E-Skills

Internet skills influence how the students accept and adopt to the cloud computing applications for educational purpose. From the table above, around 30-40% disagree to that the fact that it is difficult and tiring to look for information online and refer to any relevant website for their use. This clearly means that there are a set of students that accept the usage of online applications for educational purpose. But online search engines could also be distracting to the students. Hence, nearly 70% students end up browsing website which they initially were not intended to visit. Thus, the alternative hypothesis is that E-Skills has impact on the usage of cloud computing applications.

Discussion

The cloud-based education system is one of the most innovative and up-to-date technologies in the recent years and the adoption to this online learning system is increasing in colleges and universities. The educational systems are engaged in trying to find ways to adopt to the cloud-based service model. It would prove to be an important step for institutions to move to cloud-based environment with regards to the economic crisis, globalization and the constantly changing IT requirements. Acceptance to a cloud based online education system could also solve issues faced by the colleges and universities during and after the pandemic. The adoption to a cloud service model for the academic purpose could help in the management of knowledge to achieve high academic performance amongst students in the colleges and universities (Aydin, 2021). These e-learning platforms are flexible and dynamic with easy accessibility even with low bandwidth. These online technologies play a crucial role in performing social interaction and in the community development. It only helps in the providing information in remote areas but also reduce the work burden of teachers. The use of smart devices like laptops, mobile phones and tablets have expanded the sharing of educational information to diverse environment; which is different to the traditional educational system been restricted to classrooms. Thus, cloud-based environment is an excellent tool for creating a collaborative environment of a virtual classroom (Arul Leena Rose. P. J, 2021).

The main aim of the research was to analyze the factors that lead to the adoption of the cloud computing environment on the education system in Dublin. Hence, two main constructs such as ‘perceived usefulness’ and ‘perceived ease of use’ were analyzed and questions were asked to students in the undergraduate and post graduate degrees related to

these constructs. As mentioned previously in the literature review about ‘perceived usefulness’ in the Technology Acceptance Model, it is a variable which relates to the acceptance of a new technology and enhancing his or her performance (Davis, 1989). This clearly means that when there is a higher rate of perceived usefulness to an innovative technology, which in this case is the online e-learning cloud computing applications, there increases a chance that the user or students would be encouraged to the usage and acceptance of the cloud services. The questions in relation to perceived usefulness were to find out whether cloud applications were more efficient and useful for students in the day-to-day academia purposes. Students were also asked if the data and information sharing become faster with the use of online platforms like Google Drive or Dropbox and whether these applications have an impact on the quality of their academic work. As per the analysis, it is clear that more than 50% of the students believe that online cloud computing services prove advantageous over offline learning techniques and helps improve their performance. This also means that through an increase on the perceived usefulness, there will be positive impact on the attitude and intention to the use of mobile cloud services. Students could eventually store, upload and share different data in a local computer or a local server making academic work usable, understandable and reliable when compared to the conventional way of learning. ‘Perceived Usefulness’ emerged as one of the key constructs that influence the adoption of cloud-based applications for students. The adoption to the usage of cloud-based academic environment includes certain features of the cloud computing services such low cost, accessibility and pay as you use characteristics with regards to location, time and device used to access the services. Due to the feature of ‘perceived usefulness’ of the new technology, students feel their work is more efficient and productivity would increase. The rationale behind using the construct of ‘perceived usefulness’ for this research is to identify

the perception of students in using, accepting or adopting to the cloud services and applications for example; exchanging and sharing files or information using online applications like Dropbox, Google Drive and Microsoft OneDrive in the academic setting inside or outside the colleges; thus, eventually improving their performance and productivity. As per the analysis, it can be concluded that there has been a positive perception towards 'perceived usefulness' of cloud applications (Ghilan Al-Madhagy Taufiq-Hail, 2021).

The other construct that has been analysed in this research is 'perceived ease of use' which relates to the easiness and comfort of using a particular technology. Questions in the survey were related to how easy it is to use and learn cloud computing applications like Google Docs and Microsoft 365 for both undergraduate and post graduate students. Students were also asked if interacting or sharing information through online platforms is clear and easy to understand. 'Perceived Ease of Use' as explained in the literature review is how students find it effortless or easy to understand and use the new technology. As per the analysis of the response, it was clear that more than 70% students believed that it if it easier to use a certain technology, the greater number of students would perceive it. This means that if there is difficulty for students to understand or use the cloud computing applications, it is likely that cloud applications would have a negative perception on students. But the analysis based on 'perceived ease of use' concludes that there has been a positive impact on the adoption of cloud-based application for academic purposes for undergraduate and post graduate students (Ghilan Al-Madhagy Taufiq-Hail, 2021).

The results attained shows that there has to be a clear awareness about the cloud computing applications and services by the educational institutions managing the cloud-based environment. The research also aims to find the degree of influence of these online e-

learning services on students. Hence, question was asked to students if there were provided with enough information on cloud computing services and whether they were informed about the benefits to the extent of adopting to the e-learning applications. After analysing these responses, there has been a neutral response (approximately 30%) to whether institutions provided with enough resources to students to make themselves accustomed to the new technology of online learning. There could be a negative impact in the future if there lacks awareness about the cloud-based learning environment (Adelina Zeqiri, 2017). Another construct that proves to be a key factor for the adoption of cloud applications in institutions is the privacy and security concerns. Questions in relation to risk and security were analysed in order to identify the degree to which a student believes that using the cloud computing applications would be a threat to his or her privacy and sensitive information could be shared or leaked through the internet (Paul Ambrose, 2010). The results reflected that 30% students are concerned with the fact that using the e-learning applications could result in leaking out sensitive information. Thus, privacy concerns could negatively impact the acceptance of cloud computing services in the educational environment.

Computer Self-Efficacy is not significantly correlated to the factors influencing the adoption of cloud computing services for education but it does have a significant relationship to the degree to which cloud-based environment is used. The results obtained through the research suggest that students may currently not have enough trust on their skills and capabilities to directly use the new technology in the academia setting. Students need to feel confident to completely commit to the usage, practise and adopt to the new technology than to directly experience the new cloud-based technology. Also, since the target participants were college and university students studying undergraduate and post graduate degrees with approximately 85% of the students aged below 30 years old; it was evident that students had

less knowledge and experience with the new technology and hence encountering the new challenges with less confidence and self-esteem (Ghilan Al-Madhagy Taufiq-Hail, 2021). Another factor influencing the degree of cloud computing usage is explaining the difference in internet usage by different people with different internet skills. As explained in the literature review, E-Skills creates a clear difference on how students use and accept the cloud computing services to their advantage (Adel Ben Youssef, 2008). Hence, students were asked questions on how difficult it was to search for the relevant keyword or look for a relevant website. The analysis reflected that majority of the students disagree to the fact that it is difficult to look for relevant keywords or websites for educational purposes.

Conclusion

Educational institutions need to adopt to the digital technologies in teaching and learning in order to let the students acquire digital competency. The ICT infrastructure in Ireland is rapidly increasing and this digital learning would stimulate innovation and future employment. It is important for educational institutions in Ireland to include the use of advanced interactive teaching methods using more innovative online software (Vadim N. Korepin, 2020). The Irish Department of Education and Science need to implement a more adaptive knowledge management system based on the cloud computing applications which could contribute to improve the quality of education. Acceptance to the cloud computing applications and services could lead to a lifelong learning principle for college and university students. Teachers could inculcate professional skills to students that would prove beneficial once graduated reflecting on the future work environment. Also, with the advancement in the deployment of next generation mobile and broadband networks, the popularity in the cloud computing-based education system could be enhanced (Zhi-Qin Liu, 2020).

There would still be a question on comparison of innovative digital technologies in e-learning to the traditional methods of teaching. The cloud-based environment can significantly improve the effectiveness of education system with the use of new concepts and tools that provide new educational content and learning methods. Cloud-based environment not only provides educational process with powerful computing capabilities but also allows high availability and online security. The cloud-based infrastructure in the education system provides a huge data storage capacity by storing the data in large number of distributed network of computers. The cloud service providers need to ensure that this information is secured. It is the responsibility of the cloud service providers to manage the data, allocate the resources, deploy the software for the academic setting and monitor the platforms in real-time (Md. Anwar Hossain Masud, 2012)

The research on the adoption of cloud-based e-learning model in the colleges and universities has revealed that the decision of usage of cloud infrastructure is influenced by the need and perceived usefulness of the new technology. Due to the benefit of geographic distribution and effective cost allocation to the automated platforms and open-source software, cloud computing has proved appealing to many educational institutions. There seems to be a systematic communication between the educators and students in different geographical settings which enable a lively and interactive learning platform. This also provides the learner with active group work collaborating with different students and also implements more effective teaching methods to the educators (Lubna A. Hussein, 2020)

Limitations

There has been a rapid increase in the introduction of cloud technologies in the academia setting which brings to the question whether these digital technologies are been used as an effective teaching tool or just as a repository of electronic documents. There have also been various results from past researches reflecting that college and university staff cannot take the advantage of the potential benefits offered by the functionality of these software (Stamatios Papadakis, 2018) . Also, the key challenges for future study would include analysis of additional variable of including grade of students and innovation performance in order to predict the intent of use of cloud computing technology. Future research can be based on other factors that are relevant to the adoption of cloud computing infrastructure and their impact on not only students but also educators.

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Appendices