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IMPLEMENTING MOBILE CLOUD COMPUTING IN HIGHER EDUCATION INSTITUTIONS: A QUALITATIVE INVESTIGATION OF INFLUENTIAL FACTORS

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ABSTRACT

Aim/Purpose	The primary goal of this research is to analyze the factors that influence the implementation of Mobile Cloud Computing (MCC) in Higher Education Institutions (HEIs).

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Background — Despite MCC's benefits in lowering technology and administration costs, HEIs, particularly in developing countries such as Palestine, are skeptical and hesitant to use this technology. This research provides a model of MCC implementation based on the Technology-Organization-Environment framework (TOE) combined with the Diffusion of Innovation (DOI) model.

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Methodology — Data were collected through qualitative semi-structured interviews with a targeted sample of ten IT experts and professionals from Palestinian Higher Education Institutions (PHEIs) and local cloud service providers. The obtained data was examined using thematic analysis in the NVIVO software.

Contribution — The findings can be used as a guide for introducing MCC in higher education settings. It will lead to a better understanding of MCC implementation by HEIs, which can help institutions harness the benefits and progress offered by MCC, enabling them to overcome challenges and enhance their operations. The study will provide valuable suggestions for the initial steps HEIs can take towards MCC implementation. Moreover, it will benefit cloud service providers, as it will enhance their understanding of the factors that influence MCC implementation in HEIs. This will help them tailor their services and solutions better to meet the unique needs and requirements of the higher education sector.

Findings — The results show that data security risks, relative advantages, compatibility, complexity, top management support, competitive pressure, and cloud service provider support all have a substantial impact on MCC implementation. The interviewed IT specialists also proposed two new contributing factors (technology readiness and government support).

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Recommendations for Practitioners	The results are expected to aid decision-makers at HEIs and cloud service providers by focusing on the crucial role of the factors that appeared in the study.
Recommendations for Researchers	It is recommended that researchers in future studies test the proposed model in settings and cultures different from the context in which this study was conducted. In addition, surveying the opinions of other stakeholders and adding other factors not included in the research are important to provide different perspectives and generalize the results.
Impact on Society	Understanding the factors that influence the implementation of MCC in HEIs can enhance access to educational resources for both learners and teachers while promoting innovation in teaching and learning. Additionally, this understanding aids in the development of educational institutions, enabling them to contribute to societal progress by improving the quality of education and fostering global cooperation, ultimately leading to the advancement of society.
Future Research	Examining the long-term effects of MCC implementation on educational outcomes, student performance, and institutional efficiency will offer valuable insights into the enduring advantages and possible limitations of these technologies. Future research should also investigate the impact of emerging technologies like Artificial Intelligence (AI) and Machine Learning (ML) in enhancing the functionality and effectiveness of MCC within educational environments. Furthermore, conducting comparative research across various regions and educational systems might help to identify the socioeconomic factors that influence MCC acceptance and implementation.
Keywords	mobile cloud computing, cloud computing, higher education, diffusion of innovation, technology-organization-environment

INTRODUCTION

The field of Mobile Cloud Computing (MCC) has experienced substantial growth in research activity, primarily due to the significant role that mobile devices play in contemporary society. The portability and ubiquitous nature of mobile phones make them effective and convenient for communication anytime, anywhere. The emergence of MCC has brought about a significant transformation in computer science technology and has affected phone developers (Aliyu et al., 2020). According to Carreiro and Oliveira (2019), it is a wealthy technology related to mobile computing. It has control over integrated, flexible resources across multiple cloud environments and network technologies. It offers unbounded working, mobility, and storage. Moreover, its goal is to serve a wide scope of mobile equipment regardless of time and place, leveraging local network technologies like Ethernet and global

connectivity through the Internet, even if the environments and platforms are diverse, based on a pay-as-you-use model.

Higher education institutions (HEIs) play a crucial role in societal and national development. To improve education and research, universities have recently implemented advanced IT infrastructures. With the increasing popularity of online education, it is necessary to have a robust and secure technology system that can handle a large number of users. The efficient utilization of IT infrastructure is essential for delivering high-quality education and conducting research. However, the adoption of new technologies is often hindered by financial limitations. In recent times, cloud computing has emerged as a cost-effective solution to overcome IT infrastructure challenges (U. Singh & Baheti, 2017).

It has been observed that academic institutions have become increasingly reliant on IT for both managerial and educational activities, particularly with the emergence of e-learning. As technology continues to advance, institutions are now embracing cloud computing to take advantage of its numerous benefits. These benefits include lower IT costs, scalability, improved business continuity, enhanced collaboration efficiency, the ability to adopt flexible work practices, and access to automatic updates (Alenezi, 2019; Matar et al., 2020).

Many previous studies focused on the adoption of MCC and highlighted its benefits in higher education in developed countries. However, it is evident that there is a lack of research in identifying the main factors influencing MCC implementation in developing countries such as Palestine (Adam et al., 2019; Alghushami et al., 2020; Rahman et al., 2018; Sabi, Uzoka & Mlay, 2018; Tariq et al., 2020). Addressing this research gap is imperative, as an increasing global reliance on cloud technologies may impede efforts to enhance the quality of higher education in Palestine. In the absence of a thorough understanding of the factors affecting MCC implementation in HEIs, these organizations may face several challenges, including diminished operational efficiency, rising technical and administrative costs, and difficulties in delivering e-learning that meets the expectations of both students and faculty. Furthermore, the lack of targeted solutions could compromise the international competitiveness of Palestinian higher education institutions (PHEIs) with their regional and global counterparts. This situation risks widening the innovation gap and limiting opportunities for attracting investments in the education sector. Consequently, it is vital to address this gap, as doing so will not only enhance the technical infrastructure of HEIs but also improve the sustainability of the educational process, ensuring its adaptability to the rapid changes in the global educational landscape.

Identifying these determinants will be valuable for both HEIs and cloud service providers in shaping their strategies. Moreover, it will enable HEIs to make informed decisions when selecting cloud services, deployment models, service models, and cloud service providers based on their specific requirements (Isa et al., 2019; Sharma et al., 2020). Therefore, further research is needed to investigate the primary determinants of MCC implementation in HEIs within developing countries like Palestine.

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The objective of this research is to assess the implementation of MCC in PHEIs and to identify the key factors that affect the implementation of MCC in PHEIs. Therefore, the study aims to answer the following questions:

RQ1: How do PHEIs approach the implementation of MCC?

RQ2: What factors influence the implementation of MCC in PHEIs?

The next section provides a literature review of the MCC concept, including its definition, benefits for HEIs, usage in HEIs, its services, and implementation. The following section presents the research's theoretical background, discusses the DOI model and TOE framework, and introduces the initial research model. The methodology is then introduced, and the results are provided, followed by the discussion and conclusion. The research contribution is introduced in the next section, followed by a discussion of the limitations of the study. Finally, some ideas for future research are presented.

LITERATURE REVIEW

MOBILE CLOUD COMPUTING CONCEPT

MCC is a computing model that leverages cloud-computing resources to enhance the performance of mobile devices with limited resources (Zhou & Buyya, 2018). According to the Mobile Cloud Computing Forum, as cited by Karthik and Manhar (2020), MCC is an infrastructure that stores and executes data on external mobiles. This means that data storage and processing power are shifted to the cloud, relieving mobile devices from these tasks and utilizing mobile applications instead. Therefore, as shown in Figure 1, MCC integrates both cloud and mobile computing. In this approach, data is stored and processed on the cloud rather than on mobile devices (Vaidya et al., 2020).

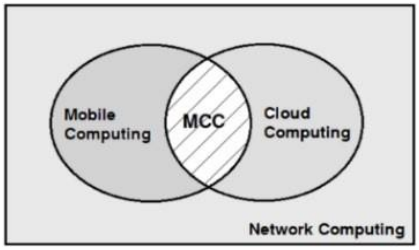

Figure 1. Foundation of MCC (Rayapuri, 2018)

Cloud computing consists of three main service models, namely Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS) (M. Ali, 2019; Matar et al., 2022; Qasem et al., 2020). SaaS allows software distribution with particular demands. In this type, the user can pay to access the information and application (via the Internet) according to the usage (pay-peruse). Examples of this type are Microsoft Office 365, Salesforce, Microsoft's Live Mesh, etc. (Rayapuri, 2018). PaaS supplies application programming

interface (API) forms, programming environments, and advanced integrated environments for constructing, experimenting, and deploying custom applications. Some examples are Google App Engine, Microsoft Azure, and Amazon Map Reduce / S3 (Rayapuri, 2018). As for IaaS, it offers physical, virtual, and extra storage networking products (Mohammed & Zeebaree, 2021). It enables supplying storage, network, servers, and networking components to the users. Using these provisions, the clients can deploy and run arbitrary software (OS, application, etc.). Examples are Amazon Elastic Cloud Computing (EC2) and Simple Storage Services (S3) (Rayapuri, 2018).

BENEFITS OF MOBILE CLOUD COMPUTING FOR HIGHER EDUCATION

HEIS can obtain various benefits from MCC. Companies such as Google, Amazon, and IBM provide free cloud services for educational purposes. This enables the delivery of high-quality education even in rural locations. Web-based cloud apps can be accessed and executed on mobile phones, eliminating the need for additional memory storage or software. Furthermore, MCC offers the added benefit of automatically installing updates for web-based programs, removing the need for manual installation. When users access the cloud, they are automatically presented with the most recent version of the software (Vaidya et al., 2020).

The internet-based nature of MCC allows money and time to be saved while increasing work efficiency and quality. Users have fewer limits regarding the availability of space and resources. The cloud provides excellent scalability, allowing teachers to manage and limit the available capacity for specific tasks. It also provides adequate storage for a large amount of data, which can be updated as needed. Furthermore, locating saved data is rather simple. The process is facilitated by the use of software integrated into the cloud system. This promotes resource pooling (Thavi et al., 2021).

Although features such as scalability, large storage capacities, and easy access to data can be achieved through traditional infrastructure if an institution has sufficient resources, MCC offers these benefits more efficiently and flexibly. Cloud services enable HEIs to reduce the costs associated with setting up and maintaining local servers, providing a flexible and scalable solution to meet changing needs. Consequently, MCC becomes an attractive option for HEIs that lack the physical or technical capabilities to provide these services internally, particularly in developing countries like Palestine.

MCC offers students the flexibility and convenience to learn and study from any location, at any time, without the expense of purchasing software and hardware since these resources are provided by the cloud. Additionally, it enables learners to access their academic materials, videos, libraries, assignments, and exams via their mobile devices. For universities, implementing mobile cloud services is both practical and economical, as it eliminates the need for significant investments in infrastructure and the burden of service updates and maintenance. All storage, computing, and updates are managed by the cloud (Almaiah & Al-Khasawneh, 2020).

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The main benefit of employing MCC in education is its capacity to enhance a range of learning processes. These processes encompass self-directed learning, peer-to-peer learning, classroom instruction, distance education, virtual labs, assessment systems, and specialized instruction for students with special needs (Asadi et al., 2020). MCC supports self-paced learning by providing educational content through cloud-based e-learning platforms that can be accessed anytime and anywhere using mobile devices (V. Kumar & Sharma, 2021). These platforms also enable real-time collaboration among students through dedicated communication and interaction tools, which enhance peer-to-peer learning (Jaiswal et al., 2024). In classroom settings, MCC facilitates access to up-to-date educational resources and offers technologies such as cloud presentations (Agrawal, 2021). Distance learning is further enhanced by virtual classrooms and live streaming, ensuring the continuity of the educational process without geographical restrictions (S. Singh, 2022). Additionally, in virtual labs, MCC allows the execution of complex simulations without the need for expensive local equipment and supports assessment systems that collect and analyze academic performance data in the cloud (Crichigno et al., 2021). Furthermore, MCC services provide specialized educational tools to assist students with special needs, including screen readers and guided learning platforms (Sivakova, 2019).

USE OF MOBILE CLOUD COMPUTING FOR HIGHER EDUCATION

HEIs can benefit from the diverse services offered by MCC in the educational context, as illustrated in Figure 2. Many educational institutions started utilizing MCC by outsourcing their student electronic mail services. They also began employing low-level cloud services such as data storage. Cloud computing has also found its way into the education sector to improve learning management systems. This is accomplished by deploying learning management systems (LMSs) such as Moodle and Blackboard in the cloud (Shakor & Surameery, 2021).

Cloud computing is frequently related to e-learning and m-learning. E-learning systems, ranging from commercial to free and open-source arrangements, have been implemented in a variety of educational sectors and teaching levels. As a result, academics may utilize e-learning systems to schedule courses, assess tasks, and share research findings (Shakor & Surameery, 2021).

Cloud computing technologies can transform the learning environment into one that is dynamic and collaborative. These technologies empower students to explore new concepts, share knowledge, improve their reflective thinking and analytical abilities, and support self-directed learning. To harness these advantages, numerous universities have begun incorporating MCC services such as Google Apps, Docs, and Space-Share into their educational frameworks. These tools promote sharing, reflection, communication, and collaboration among students (Baanqud et al., 2020).

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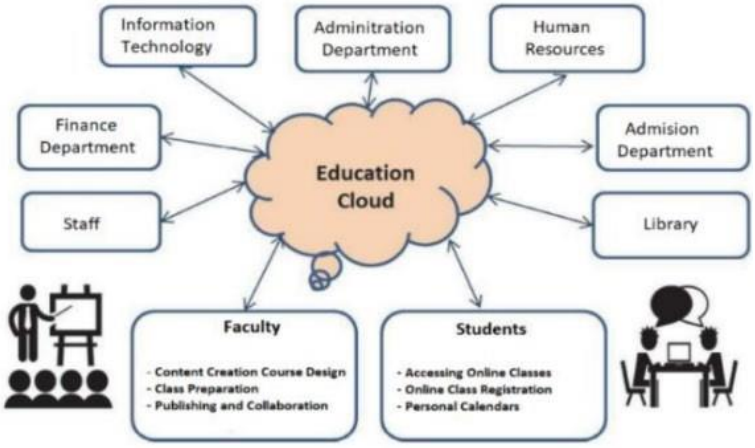

Figure 2. Cloud-based services at HEIs (A. Ali, 2020)

Globally, educational institutions are rapidly using MCC technology to improve their data management operations (Almajalid, 2017). Platforms such as Google Classroom, Azure from Microsoft, and AWS (Amazon Web Services) are gaining popularity due to their extensive capabilities, dependability, and convenience of use. These platforms provide a wide range of services, from simple storage of files to sophisticated analysis of data, successfully meeting the different needs of educational institutions (Suroso, 2024).

FEATURES OF MOBILE CLOUD COMPUTING SERVICES

MCC has many features that justify the transition from the traditional method of work to using MCC. Among these are the following:

- It reduces costs by utilizing cost-effective solutions. By using MCC services, companies can avoid spending large amounts of money on servers, software, and hardware needed to create on-premises data centers. Instead, organizations only spend money based on their usage and can easily keep an eye on their consumption (Vaidya et al., 2020). In the context of HEIs, utilizing MCC can significantly reduce both initial and ongoing costs. Additionally, by leveraging cloud services, the need for IT staff will diminish, resulting in further savings. Addressing a catastrophe and maintaining operations can be expensive for an organization, but such costs can be minimized with cloud usage. Furthermore, MCC can lead to cost savings when developing and experimenting with solutions in the educational environment (Hussein & Hilmi, 2020; Jaradat et al., 2020; Olaloye et al., 2019; Shukur et al., 2020).
- These services operate through a global network, and the hardware is continually upgraded to enhance efficiency. Applications can be delivered anywhere in the world in a matter of moments (Vaidya et al., 2020).
- Another benefit of using MCC is the availability of data and services. The user can access his data at any time easily, and various users can access the same data at the

same time (Paranjothi et al., 2017). This means that cloud services can usually be accessed at any time during the year from different browsers (Safari, Chrome, Mozilla, Firefox, etc.). Moreover, access to these resources may be done using different types of devices (iPad, PC,
Smartphone, etc.). This feature allows users to adapt to their work (Saini et al., 2019).

- MCC services are highly reliable because they serve as data backups and can additionally be utilized for disaster recovery. Data can be kept in multiple duplicate locations that can be accessible in the event of a data failure (Vaidya et al., 2020).
- Flexibility is another feature of MCC. This elasticity feature means that the cloud offers countless resources, which supplies users with any volume at any time according to their needs (Isa et al., 2019). In the higher education context, the learning environment or the resources will be modified to suit the lecturer's requirements. (Al-Ammary & Saleh, 2021; Almaiah & Al-Khasawneh, 2020; Jaradat et al., 2020; Olaloye et al., 2019; Paranjothi et al., 2017; Qasem et al., 2020; Shukur et al., 2020; Thavi et al., 2021).
- The cloud is compatible with a wide range of technologies, allowing for faster development and evaluation of innovative concepts aimed at enhancing user experience (Vaidya et al., 2020).
- Using MCC will decrease energy consumption and prolong battery life. Among the main issues in cloud infrastructure is energy efficiency. Mobile users have a big interest in the battery lifetime. Using MCC means moving the complex computations that require heavy processing from devices of limited sources to servers full of resources in the cloud system. Due to the previous idea (offloading), the execution time will be short, consuming less power and leading to effective storage and computation (Karthik & Manhar, 2020).
- Using MCC leads to robust mobile applications. MCC enables developers to produce more sturdy applications for mobile devices than before due to the powerful cloud that mobile devices can access (Karthik & Manhar, 2020).

IMPLEMENTATION OF MOBILE CLOUD COMPUTING IN HIGHER EDUCATION

Investigating the implementation and use of information technology becomes an essential requirement to recognize the potential benefit it gives to businesses, as well as the difficulties and possibilities it causes (Matar et al., 2022). Before implementing MCC in HEIs, experts and technical staff need to evaluate the factors that influence MCC adoption (Rahman et al., 2018). Amron et al. (2019) argued that technology acceptance could be divided into two categories: "accepted" and "not accepted." According to Davis (1989), acceptance refers to the user's decision regarding when and how to use the technology. However, before users or organizations adopt the technology, several factors need to be taken into account, as various challenges and issues often influence the acceptance process.

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Research on innovation adoption and acceptance can be divided into two primary categories: individual concerns and organizational concerns. According to Qasem et al. (2019), organizational adoption encompasses the integration of innovation across various individuals and hierarchical levels within an organization. This might include, for example, the implementation of a new technology organizationwide. Conversely, individual adoption focuses on how specific people within the organization accept the innovation.

While extensive literature addresses innovation usage at the individual level, some researchers also examined its adoption at the organizational level. At this broader level, as Qasem et al. (2020) noted, studies often concentrate on the perspectives of decision-makers who oversee and control the adoption process. In this scenario, individual members of the organization merely observe the outcomes of these decisions. Table 1 reveals that most previous studies concentrated on individual acceptance of innovation rather than organizational acceptance. This indicates a need for more research exploring innovation usage in HEIs from an organizational perspective.

Table 1. Studies of MCC use in HEIs

Adoption level	Frequency	Study
Individual	32	Hashim et al. (2022); Matar et al. (2022); Katheeth et al. (2022); AlHajri et al. (2021); Al-Malah et al. (2021); Rossiman et al. (2021); Taufiq-Hail et al. (2021); Matar et al. (2020); Yadegaridehkordi et al. (2020); Shahzad et al. (2020); Raza et al. (2020); Mary and Rose (2020); Hamutoglu (2020); Jaradat et al.(2020); Hussein and Hilmi (2020); Sultana (2020); Alhamazani (2020); Shukur et al. (2020); Almaiah and Al-Khasawneh (2020); Hiran and Henten (2020); Asadi et al. (2020); Almazroi et al. (2020); Abdulfattah (2021); Yadegaridehkordi et al.(2019); Arpaci (2019); Juma and Tjahyanto (2019); Kayali et al. (2019); Al-Harethi and Garfan (2018); Chaveesuk (2018); Sabi, Uzoka and Mlay (2018); Rahman et al. (2018); Alsmadi and Prybutok (2018)
Organizational	20	Al-Ramahi et al. (2022); Badie et al. (2022); Mahmood et al. (2022); Aldahwan and Ramzan (2022); Too et al. (2021); Bhardwaj et al. (2021); Thavi et al. (2021); Al-Ammary and Saleh (2021); Sharma et al. (2020); Odeh (2020); Alghushami et al. (2020); Hamed and Preece (2020); Abdulatif and Hamad (2020); Qasem et al. (2020); Adam et al. (2019); Isa et al. (2019); Njenga et al. (2019); Aziz et al. (2019); Qasem et al. (2018); Sabi, Uzoka, Langmia, et al. (2018)

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Numerous researchers explored the acceptance, implementation, and adoption of MCC in HEIs using various models and frameworks (see Appendix A). Some focused on a single model: Raza et al.
(2020), Hussein and Hilmi (2020), and Abdulfattah (2021) employed the Technology Acceptance Model (TAM), while Hamutoglu (2020) and Almazroi et al. (2020) used TAM3. Other studies utilized the Technology-Organization-Environment (TOE) framework, such as those by Alghushami et al. (2020), Shahzad et al. (2020), Njenga et al. (2019), Tarhini et al. (2018), and M. Ali (2019). Asadi et al. (2020) used the Theory of Planned Behavior (TPB), whereas Matar et al. (2022), Yadegaridehkordi et al. (2020), Jaradat et al. (2020), Matar et al. (2020), and Alsmadi and Prybutok (2018) applied the Unified Theory of Acceptance and Use of Technology (UTAUT).

Some researchers integrated multiple models to understand MCC or Cloud Computing (CC) acceptance better. For instance, Al-Ammary and Saleh (2021), Qasem et al. (2020), Hiran and Henten (2020), Isa et al. (2019), and Adam et al. (2019) combined TOE and Diffusion of Innovations (DOI), while Mahmood et al. (2022) combined TOE and UTAUT, and Katheeth et al. (2022) used TAM and TPB. Al-Sharafi et al. (2021) incorporated TOE, Functional Value Model (FVM), DOI, and Innovation Network Theory (INT), and Al-Ramahi et al. (2022), Aldahwan and Ramzan (2022), and Bhardwaj et al. (2021) utilized TAM, TOE, and DOI.

In contrast, some researchers expanded existing technology acceptance models by introducing new external factors. For example, Sultana (2020) added mobility and self-management learning to UTAUT, Jaradat et al. (2020) incorporated trust into the UTAUT model, and Alhamazani (2020) extended UTAUT2 by including awareness, perception of security, and bandwidth speed. Yadegaridehkordi et al. (2019) expanded TAM with mobility, collaboration, and personalization, while Rahman et al. (2018) added trust, complexity, perceived risk, technophobia, technophilia, and skill transferability to UTAUT2. Sabi, Uzoka, and Mlay (2018) integrated socio-cultural factors, poor ICT infrastructure, low upfront cost, risk, and data security into DOI theory. Arpaci (2019) extended the Theory of Reasoned Action (TRA) by introducing information retrieval, storage, sharing, and application.

Additionally, some researchers chose specific factors from the literature without adhering to a particular framework or model, as seen in studies by Thavi et al. (2021), Almaiah and Al-Khasawneh (2020), and Sharma et al. (2020). The literature indicates that at the organizational level, the most commonly used frameworks are TOE and DOI. However, when it comes to studying the use of MCC at the individual level, TAM and UTAUT emerge as the dominant models.

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MCC rates exhibit considerable variation across different regions and sectors. Developed countries, including Japan, Australia, and the United States, report higher adoption rates compared to developing nations. This disparity is often attributed to challenges developing countries face, such as unsupportive policies, migration issues, and conservative business cultures (Ferdiana & Putra, 2018). In Asia, as noted in Sangfor Technologies (2023), Singapore is at the forefront with its "Smart Nation" initiative, where the public cloud market is expected to reach $3.6 billion in 2023, making it the leader in cloud adoption in the Asia-Pacific region. China is also making strides, with its cloud market projected to reach $90 billion by 2025, driven by the implementation of cloud technologies in the industrial and government sectors. In Japan, the expansion of broadband services and stringent privacy laws are fostering growth in cloud computing, with the market expected to increase by $13.49 billion between 2022 and 2027. South Korea is another key player in cloud computing adoption, with a market estimated to be worth $8.126 billion in 2023, supported by technological innovations and government initiatives for digital transformation (Sangfor Technologies, 2023).

In the West, the United States is demonstrating clear leadership in cloud computing, with cloud market revenues expected to reach $258.1 billion in 2023. This growth is driven by widespread digital transformation and enterprise adoption of cloud services. In Canada, cloud computing has significantly reduced IT infrastructure costs and improved operational efficiency, with revenues forecast to exceed $1 trillion by 2026. In Europe, Germany and the United Kingdom are emerging as major players in this sector, with public cloud market revenues estimated at $23.96 billion and $23.61 billion, respectively, in 2023. This growth is fueled by digital transformation and enterprises seeking to enhance operational agility and customer experience. Italy is also making strides in cloud adoption, spurred by public sector digitization and investment from multinational companies, with revenues projected to reach $9.198 billion in 2023 (Sangfor Technologies, 2023).

Australia is experiencing rapid growth in cloud spending as well, with forecasts indicating it will reach $22.4 billion by 2026, driven by advancements in artificial intelligence and big data analytics. While these countries illustrate the potential of cloud computing to drive innovation and improve services, challenges such as inadequate digital infrastructure, a lack of technical expertise, and security and cultural concerns continue to hinder the full deployment of this technology (Sangfor Technologies, 2023).

Research conducted in Europe and sub-Saharan Africa has identified several critical barriers to cloud adoption. These include concerns related to trust, security, loss of data control, costs, privacy, Service Level Agreements (SLAs), and government regulations. In Norway, these challenges have had a detrimental impact on adoption decisions, while in Nigeria, they appear to have had a more favorable effect (Dahiru & Abubakar, 2018).

The adoption of cloud computing within HEIs has gained considerable global momentum, largely due to its benefits, including cost reduction, enhanced productivity, and improved decision-making (Mohammad et al., 2021). Nonetheless, adoption rates remain relatively low, particularly due to prevalent concerns regarding trust and security issues (Arkorful, 2019). This situation is particularly pronounced in developing regions such as Kurdistan in Iraq, where the understanding and implementation of cloud computing are still in the early stages. Critical factors influencing adoption include the robustness of internet infrastructure and government support (Ahmed & Allawi, 2020). In the context of India, the integration of cloud computing in public universities has been driven by a combination of factors, including technological readiness, technology compatibility, government support, competitive advantage, strong leadership endorsement, and collaboration with vendors. However, security concerns remain a significant challenge that hinders broader adoption (Bhardwaj et al., 2021).

Hamed and Preece (2020) conducted a comprehensive study in Malaysia that focused on the utilization of the Google Cloud Platform (GCP). Their research revealed that, despite the platform's significant potential to reduce IT expenses and enhance business performance, HEIs in developing countries, such as Malaysia, have yet to embrace it fully, resulting in relatively low adoption rates. The study identified several factors that positively influenced IT managers' support for GCP applications, including performance expectancy, scalability, effort expectancy, and cost advantages. Conversely, obstacles to the adoption of GCP among HEIs included concerns regarding vendor reliability, psychological commitment, loss aversion, and the absence of regulatory policies.

Saudi Arabia is a developing country where the topic of cloud computing adoption has been extensively studied. Research has shown that adoption rates are significantly influenced by attitudes and behavioral intentions. Key factors in the adoption process include ease of use, trust, perceived usefulness, and peer influence (Al-Ghaith, 2023). Additionally, a study by Alhamazani (2020) utilized an adapted UTAUT2 model that incorporates awareness, security perception, and bandwidth speed to explain faculty members' intentions toward adopting cloud applications. The study indicates that cloud technology provides advantages in terms of performance, cost, and size for higher education, along with a variety of benefits for users (Albalawi & Almalki, 2022). In the realm of quality education, cloud computing is regarded as a solution to accessibility issues, offering both reliability and flexibility (A. Ali, 2020).

THEORETICAL BACKGROUND

There are two main theoretical frameworks currently utilized in the study of technology: technology adoption and implementation science. Technology adoption primarily examines how end users embrace new technologies, while implementation science focuses on the strategies, interventions, and factors that facilitate the integration of evidence-based practices (Schoville & Titler, 2015). Numerous theories and models have been created to explore how technologies are implemented and adopted at different levels, including societal, organizational, and individual (Bhardwaj et al., 2021; Njenga et al., 2019).

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These models include the Technology-Organization-Environment (TOE) Framework by Tornatzky et al. (1990), the Diffusion of Innovation (DOI) by Rogers (1983), the Technology Acceptance Model (TAM) by Davis (1989), and the Unified Theory of Acceptance and Use of Technology
(UTAUT) by Venkatesh et al. (2003). Other notable models are the Theory of Reasoned Action
(TRA) by Ajzen and Fishbein (1980), the Theory of Planned Behavior (TPB) by Ajzen (1985), the Human-Organization-Technology (HOT) Fit by Yusof et al. (2008), and the Task-Technology Fit (TTF) by Goodhue and Thompson (1995). There are also many other influential frameworks. In studies on technological innovation, researchers focus on various factors, such as technological, organizational, environmental, and individual aspects. These theories are employed to evaluate the acceptance and satisfaction levels of users towards information systems or technology from different viewpoints based on the constructs of each theory (Momani et al., 2017).

This study aims to investigate the influential factors on MCC implementation in HEIs at the organizational level by integrating the TOE framework and DOI model. Previous studies also merged these two frameworks to investigate technology usage within organizations (Adam et al., 2019; Al-Ammary & Saleh, 2021; Aldahwan & Ramzan, 2022; Al-Ramahi et al., 2022; Isa et al., 2019; Qasem et al., 2020). In a study conducted by Ikumoro and Jawad (2019), researchers underlined the importance of the TOE and DOI theories in understanding the use and acceptance of technology at the organizational level, as well as the degree of alignment between them.

The TOE framework stands out because it encompasses three key contexts: technology, organization, and environment. These contexts are crucial in shaping an organization's decision to adopt and utilize new technology. The research findings underscore the significance of these three contexts in ensuring the successful implementation of innovative technologies (Ikumoro & Jawad, 2019).

DIFFUSION OF INNOVATION THEORY (DOI)

The Diffusion of Innovations (DOI) framework, introduced by Rogers (1983), is a comprehensive model for understanding the acceptance and adoption of innovations and the factors that influence them. Innovations, in this context, encompass new products, ideas, methods, services, or inventions. The DOI framework, applicable across various fields, identifies five characteristics of an innovation that influence a user's decision to adopt or implement it: relative advantage, complexity, compatibility, observability, and trialability (Qashou & Saleh, 2018).

Alkhwaldi and Kamala (2017) emphasized DOI as a prominent model used to examine the acceptance and adoption of information systems and technologies at both organizational and individual levels. Rogers (1995) differentiated between diffusion and adoption in his work. Diffusion is the process through which an innovation is communicated over time among the

members of a social system via specific channels, while adoption is the decision to use the innovation as the best available option (Rogers, 1995).

Despite widespread use in studying IT diffusion in societies, the DOI framework faced criticism. Alkhwaldi and Kamala (2017) argue that DOI's explanatory power is limited, suggesting it is more effective as a descriptive tool. They also highlighted DOI's shortcomings in predicting outcomes and providing strategies to enhance adoption rates. Additionally, they pointed out that DOI does not adequately address the impact of attitudes on the adoption decision, its limitations in various cultural contexts, and the necessity of incorporating social contexts in academic studies to optimize the framework's effectiveness.

TECHNOLOGY-ORGANIZATION-ENVIRONMENT (TOE) FRAMEWORK

Tornatzky et al. (1990) created the Technology-Organization-Environment (TOE) framework, which is an important paradigm for investigating the factors that influence the acceptance and deployment of technological breakthroughs inside institutions. According to Sallehudin et al. (2020), the TOE framework investigates organizational-level characteristics in three contexts: technical, organizational, and environmental.

The technological context refers to the unique elements of the technology, whereas the organizational context encompasses factors such as the institution's size and resource capabilities. The environmental context includes both the industry structure and the larger business environment in which the institution works. Researchers, notably Sallehudin et al. (2020), Sallehudin et al. (2019), and Hassan et al. (2017), emphasized that the TOE model reveals that these contextual characteristics strongly impact innovation usage, particularly in the realm of cloud computing.

INITIAL RESEARCH MODEL

By integrating DOI theory and the TOE framework, we can successfully study how information technology is implemented. This model integration increases our knowledge of the implementation process by incorporating DOI theory into the technological context and taking into account the TOE framework's environmental impact. DOI theory had previously been criticized for failing to account for external circumstances; however, when integrated with the TOE framework, its power is increased. Furthermore, the TOE framework is adaptable and can be used for organizations of any size and industry, making it an excellent choice for researching technology usage. Previous studies show its efficacy in various areas. Figure 3 depicts a comprehensive overview of the starting framework for this study.

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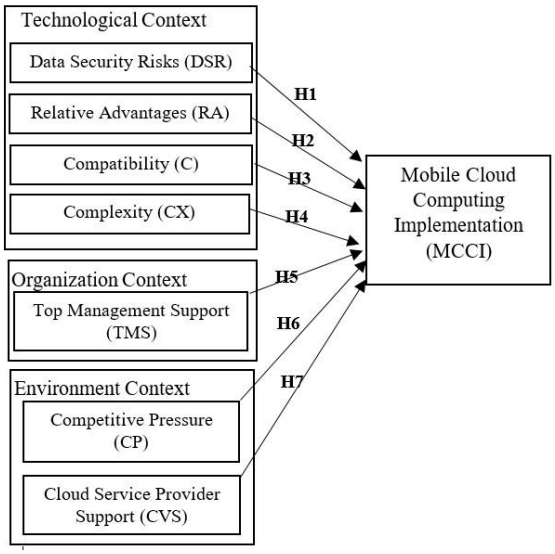

Figure 3. Research initial framework

The Diffusion of Innovations (DOI) framework is well suited for evaluating the implementation of MCC in HEIs, especially considering that MCC is still a relatively new technology in many regions. While the Technology-Organization-Environment (TOE) framework covers three contexts, it provides a comprehensive perspective that can effectively complement DOI, as previous studies have shown. This research aims to identify the key factors that influence the implementation of MCC in HEIs. To achieve this objective, a list of constructs was developed, which includes data security risks, relative advantages, compatibility, complexity, top management support, competitive pressure, and cloud vendor support. These factors were selected following an extensive literature review conducted by the authors on their influence on MCC implementation in HEIs. The review involved a systematic search and analysis of studies based on the DOI and TOE frameworks, focusing on key factors commonly cited in the literature, particularly those listed in Table 1.

Data security risks (DSR)

The safe storage and preservation of data is crucial for data security. It helps prevent unlawful access or corruption (Sarode & Bakal, 2020). To achieve this, several strategies are used, such as tokenization, key management, and encryption. The essential qualities that data should possess are part of the CIA triad, which includes availability, confidentiality, and integrity. Additionally, cloud data access is associated with characteristics like authorization, authentication, and nonrepudiation (P. R. Kumar et al., 2018).

Concerns about data security are a barrier for businesses considering adopting cloud services (Alkhater et al., 2018). Users of cloud services often worry about ownership, privacy, security, theft, and data loss. Furthermore, the physical location of data centers presents challenges due to different data privacy regulations in different countries. Organizations are

hesitant to accept or implement MCC due to its lack of robust safety features and procedures (Bhardwaj et al., 2021).

Relative advantage (RA)

Relative advantage measures how much more beneficial an innovation is compared to what it replaces, including its visibility and impact on an institution. MCC services have demonstrated significant benefits, such as reducing network infrastructure load, enhancing collaboration, lowering costs, simplifying hardware maintenance, and improving administrative efficiency through automation (AlAmmary & Saleh, 2021). Furthermore, MCC ensures accessibility, availability, speed, and performance, offering quick server responses, scalability, and flexibility (Isa et al., 2019).

Research consistently highlighted the positive impact of MCC and CC adoption in various studies
(Adam et al., 2019; Al-Ammary & Saleh, 2021; Alghushami et al., 2020; Almaiah & Al-Khasawneh, 2020; Hiran & Henten, 2020; Isa et al., 2019; Mahmood et al., 2022). MCC's unique advantages include pay-per-use models, resource sharing, mobility, and accessibility from any location. It also opens new avenues for education and research and provides faster and more streamlined services (Bhardwaj et al., 2021). Consequently, the implementation of MCC is expected to yield positive outcomes.

Compatibility (C)

The acceptability of an invention is affected by its perceived compatibility with an institution's present values, knowledge, and adopters' needs (Hiran & Henten, 2020). Other aspects that influence compatibility include existing technology architecture, organizational culture, present interfaces, formats, and organized data. HEIs are more likely to implement an invention that they believe is technologically harmonic (Bhardwaj et al., 2021). This factor has been thoroughly examined and found to have a considerable impact on the invention's acceptance (Adam et al., 2019; Alghushami et al., 2020; Bhardwaj et al., 2021; Hiran & Henten, 2020; Isa et al., 2019; Qasem et al., 2020; Shukur et al., 2020).

Complexity (CX)

Complexity pertains to how challenging an organization finds it to understand and utilize an innovation (Qasem et al., 2020). The intricacy of middleware and underlying infrastructure can influence the broad adoption and implementation of MCC and CC (Sharma et al., 2020). When organizations lack technological expertise and experience and face difficulties integrating the technology with business operations, its use can become complex. Assessing MCC complexity involves factors such as task duration, data transmission efficiency, integration with MCC infrastructure, system characteristics, functions, and interface design (Bhardwaj et al., 2021).

This complexity was examined in several studies, considering these various aspects (Adam et al.,

2019; Aldahwan & Ramzan, 2022; Alghushami et al., 2020; Bhardwaj et al., 2021; Hamed & Preece, 2020; Hiran & Henten, 2020; Isa et al., 2019; Qasem et al., 2020; Sabi, Uzoka & Mlay, 2018; Sharma et al., 2020; Shukur et al., 2020).

Top management support (TMS)

Top management support reflects the degree of awareness and proactive measures taken by senior leaders to acknowledge the value of innovation for the institution. Such support guarantees a strategic vision, proper resource allocation, and effective resource management. Research indicates that IT projects lacking adequate top management backing often fail (Hiran & Henten, 2020). Numerous studies highlighted the crucial role of top management support in the adoption of MCC and CC (Adam et al., 2019; Al-Ammary & Saleh, 2021; Aldahwan & Ramzan, 2022; Alghushami et al., 2020; Bhardwaj et al., 2021; Hiran & Henten, 2020; Isa et al., 2019; Mahmood et al., 2022; Qasem et al., 2020; Sharma et al., 2020a; Shukur et al., 2020).

When top management supports these initiatives, it shows their dedication to providing the necessary resources for implementing new technologies. It also ensures their active involvement, long-term vision, the creation of a supportive organizational environment, and the ability to overcome resistance to change associated with new technology adoption. Consequently, if the university's top management recognizes the benefits of MCC, they are more likely to allocate the needed resources to facilitate the implementation of this technology (Bhardwaj et al., 2021).

Competitive pressure (CP)

Competitive pressure is the tension that institutional leaders experience when their competitors acquire or implement MCC services and gain considerable educational benefits (Qasem et al., 2020). This competition among colleges encourages them to be more inventive and keep a competitive edge in their respective fields. In response to this pressure, organizations are driven to investigate and use new technologies to improve their ability to innovate (Mahmood et al., 2022). Previous research highlighted competitive pressure as a significant element impacting the adoption of MCC or CC (Adam et al., 2019; Al-Ammary & Saleh, 2021; Hiran & Henten, 2020; Qasem et al., 2020; Sharma et al., 2020a).

Cloud vendor support (CVS)

The role of the cloud vendor is essential in the cloud ecosystem, providing support for various IT functions such as storage solutions, backup operations, and platform development and testing (Isa et al., 2019). When an organization transitions to a cloud environment, it depends heavily on the cloud service vendor for these services. Thus, vendor support is critical for the successful implementation of MCC within the organization. This support encompasses user training, infrastructure customization, technical assistance, data availability, and compliance with security regulations. As a result, strong vendor support is anticipated to have a positive effect on the organization's intention to adopt MCC (Bhardwaj et al., 2021).

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METHODOLOGY

This study employed the qualitative research approach, which involves using various research tools and strategies to investigate people's communal, financial, religious, societal, political, and social viewpoints through non-quantitative data. It involves gaining knowledge on particular phenomena from various kinds of sources, including text, audio, and images (Saldana, 2011). The qualitative method highlights the phenomenological idea, which states that reality is dependent on people's perceptions. This approach prioritizes meaning and comprehension under ordinary conditions (Joyner et al., 2018).

In this study, a case study approach was utilized to investigate HEIs in Palestine. A case study is a qualitative research design that is employed to conduct an in-depth study of a specific subject over a defined period. This method is particularly useful when limited information is available about the topic under investigation or when it is not fully understood (Alharbi et al., 2017; Leedy & Ormrod, 2015). Additionally, a case study allows for thorough testing of research questions and the comprehensive development of notations (Gustafsson, 2017).

RESEARCH INSTRUMENT

The qualitative data was collected through in-depth semi-structured interviews. This type of interview is commonly used in qualitative research. The main goal of the researcher is to obtain specific information that can be compared with the information gathered from other interviews. To ensure consistency, the researcher asks the same questions in each interview while still allowing flexibility to gather additional valuable insights (Dawson, 2019).

To establish rapport with the respondent expert, the interview began with general questions about the respondent's demographic information, focusing on their experience in MCC and the number of years they have worked in this field at their educational institution. Then, the demographic details about the institution itself were gathered. Next, a series of questions regarding the implementation of MCC at the targeted educational institution were asked, specifically addressing the scope and extent of implementation, as well as the service and deployment models used, along with justifications. Then, the types of MCC services that had been implemented were identified, and their effects on both the educational and administrative processes were discussed. Following this, the advantages and disadvantages, incentives, and obstacles that the institution faced during the implementation of MCC were inquired. These questions aimed to address the first research question related to the status of MCC implementation in HEIs in Palestine.

In the second part of the interview, questions were posed regarding the factors influencing the decision of HEIs to implement MCC. Each participant was asked to evaluate a set of factors derived from the literature, which were identified as the most important in this context. Respondents indicated whether each factor was "Very important," "Important," "May be important," "Not important," or "Not relevant." Additionally, they were asked to

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explain how these factors affected the implementation process. Finally, respondents were invited to suggest any other factors affecting the implementation of MCC that were not listed. Alongside these questions, probing inquiries were included to explore the respondents' answers in more detail or to clarify any unclear points. Follow-up questions are crucial in qualitative interviews as they elicit deeper insights and encourage respondents to clarify or expand their answers. For more information, see Appendix B.

RESEARCH POPULATION

This qualitative study was specifically aimed at IT experts and professionals in PHEIs with experience in MCC or CC, focusing on data security. The study sought participation from deans of IT colleges, heads of IT departments (such as computer engineering, computer science, and management information systems), as well as heads of computer centers, and technical professionals in IT centers within universities. Local cloud service providers in Palestine were also included in the study. Participants were required to possess extensive knowledge in IT, particularly in data security within CC and MCC, have at least five years of experience working in a PHEI, and hold positions that enable them to make crucial IT sourcing decisions. The demographic data of the informants can be found in Table 2.

Table 2. The demographic data of the informants

Code	Gender	Age interval	Education level	Experience in IT	Experience in CC	Job title
P1	Male	41-50	PhD	11-15 years	Advanced	Dean of IT College
P2	Male	More than 50	Bachelor	16 years or more than	Expert	Cloud Service Provider
P3	Male	41-50	Master	16 years or more than	Advanced	Assistant to the University President for IT Affairs
P4	Male	41-50	Master	16 years or more than	Advanced	Computer Centre Director
P5	Male	41-50	Master	More than 16 years	Advanced	Head of Technology Infrastructure Department
P6	Male	31- 40	PhD	11-15 years	Advanced	Head of the Computer Systems Engineering Department

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P7	Male	41-50	Master	16 years or more than	Intermediate	Networking Supervisor in Datacenter
P8	Male	More than 50	Bachelor	16 years or more than	Advanced	Data center manager
P9	Male	41-50	Master	16 years or more than	Expert	Computer Centre Director
P10	Male	41-50	Master	16 years or more than	Intermediate	Head of Software Engineering in the Datacenter

SAMPLING STRATEGY AND SAMPLE SIZE

In this qualitative research, a purposeful sampling technique was utilized, enabling the selection of individuals best suited to contribute to the understanding of the phenomenon being studied (Creswell, 2012). Data saturation, the point at which no new themes or codes emerge from the data, is an important consideration when determining sample size and is commonly referenced in thematic analysis research (Braun & Clarke, 2021). While the accurate sample size in demand to fulfill data saturation is still debated, factors such as the study's scope and techniques utilized, including interview duration, are believed to play a role in achieving this objective (Ken-Giami et al., 2022; Mason, 2010).

Conversely, the community readiness literature recommends conducting 4 to 6 key informant interviews (Kostadinov et al., 2015; Muellmann et al., 2021). Some researchers provided limited sample sizes in qualitative phenomenological research, suggesting that the sample size should range from five to twenty-five (Creswell, 2007), with Morse (1994) establishing a minimum of six participants. Similarly, Namey et al. (2016) found that a sample size of eight to sixteen interviews suffices for addressing evaluation-related research questions. In a previous study by Coenen et al. (2012), saturation was achieved after nine interviews.

In the present study, data saturation was achieved by first purposively sampling six IT experts, generating initial codes, and subsequently conducting interviews with four additional participants. Analysis of the new data revealed no new findings, confirming data saturation. Therefore, the sample size for this study was ten participants.

DATA COLLECTION

To ensure that the interview questions in our qualitative study were open-ended enough to gather relevant data, we conducted an expert review before the actual interviews took place. The interview guide needed clarification, validation, and improvement, and we wanted to identify any potential sensitivity or bias in the questions. For this process, we used a pre-defined model called the CODE scheme, which is a modified version of the QAS-99 developed by Willis and Lessler (1999).

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We sent the first draft of the interview guide to ten experienced academic researchers and practitioners via email, asking for their input. Out of the ten specialists, four agreed to review the guide and provide comments. Based on their feedback, we made adjustments to the interview questions. For example, some questions were removed, while others were combined. We also reworded certain questions to address sensitive topics, such as university policies for protecting private information.

In-depth semi-structured interviews were employed to gather qualitative data. Individual semi-structured interviews enable researchers to use predetermined questions and allow interviewees to respond freely in their own words (Bryman, 2004). Additionally, this approach allows researchers to ask follow-up questions based on the interviewees' reactions or responses to previous questions. Consequently, the researchers gained a more comprehensive understanding of the research topic (Bryman & Bell, 2015).

Seven of the ten interviews for this study were conducted in person, while the remaining three were conducted by Zoom. The use of Zoom was necessary due to the geographical distance and security issues in Palestine. Before the interviews, experts were contacted and provided with a briefing on the study's aim. An interview schedule was then agreed upon. Before each interview, participants received detailed information about the research and a confidentiality guarantee. They were also given the option to stop the recording at any time. Consent forms and demographic details were collected in advance. The interviews took place between December 28, 2023, and March 6, 2024, and were conducted by one of the participating researchers.

As the informants' mother tongue is Arabic, the interviews were conducted in that language. Only seven of the participating experts agreed to have their interviews recorded electronically for later data analysis. The remaining three interviews were fully recorded manually, using pen and paper. Participants were informed in advance about the recording process, and the researcher assured them that their data and answers would be protected and used solely for scientific research purposes.

With the approval of the participating experts, in-person interviews were recorded using a mobile phone recorder. With the experts' permission, the recording feature in the Zoom application was turned on for virtual interviews. If an expert did not want their voice recorded, interviews were physically transcribed on paper, whether they were face-to-face or virtual. The interview transcripts were translated from Arabic to English by one of the team's researchers before being entered into the NVIVO program. A specialist with a PhD in English, who is also an assistant professor at a government university in Palestine, verified their accuracy. The transcripts were further proofread using AIpowered translation software. Additionally, a reverse translation process from English to Arabic was performed to ensure that the translation accurately reflects the original meanings and concepts.

DATA ANALYSIS

The interview data, comprising qualitative responses from participants, was imported into NVIVO12, a widely used software specifically designed for Qualitative Data Analysis.

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NVIVO12's robust features include efficient data management, query execution, and data tracking, making it a popular choice among researchers (Ken-Giami et al., 2022). The data was meticulously analyzed using thematic analysis, an inductive approach that allows meaningful themes to emerge directly from the data without imposing preconceived categories. This method involves concurrent data collection and analysis, ensuring a comprehensive understanding of the dataset (Dawson, 2019).

The steps for conducting thematic analysis with NVIVO 2012 are based on established procedures used in qualitative research. These processes were motivated by the rules and methodological framework created by Braun and Clarke (2006). Their influential work outlines a six-phase procedure for thematic analysis, which has been widely used and modified in qualitative research. The coding process began with a careful reading of the interviews, identifying relevant phrases, and assigning codes based on themes aligned with the study objectives. The codes were organized within NVIVO, with adjustments made as needed, such as reordering or merging codes that overlapped. The code groups were then linked to appropriate themes, which were organized according to the study questions and objectives. A colleague reviewed the coding system, and Excel was occasionally used to assist with organization and arrangement. Finally, the steps and results were presented to the other researchers for review and feedback to ensure the accuracy of the results.

In detail, the initial stage of the analysis consisted of familiarizing oneself with the data. All interviews were transcribed word for word to maintain accuracy and immerse oneself in the data. The transcriptions were read and reread several times, enabling the emergence of initial ideas and possible themes. This iterative reading process facilitated the development of a profound comprehension of the content.

After becoming familiar with the data, the transcribed interviews were imported into NVIVO 2012. The initial coding process involved systematically going through each transcript and creating codes for interesting aspects of the data. This included labeling relevant segments of data that related to the research questions. NVIVO's coding capabilities allowed the organization of data into logical categories, making it easier to discover repeating trends. Once the initial coding of all the data was complete, the following stage was to examine the codes and organize them into probable themes. To investigate the correlations between codes and discover broad themes that highlighted important trends in the data, NVIVO's query tools were used. This stage necessitated a repeated method of improving the codes and themes to make sure that they appropriately reflected the data.

The identified themes were then examined and improved to guarantee a consistent pattern and an accurate representation of the data. This method included two stages of review. The first stage involved analyzing the coded data extracts for each theme to confirm that there were clear distinctions between themes and that each theme was internally coherent. The second stage entailed revisiting the whole data set to evaluate the themes' relevance to the data set and ensure that no relevant material was ignored. After conducting a comprehensive review, each theme was defined and named. This process included a detailed analysis of each theme to determine its essence and identify the specific aspect of the data it represented.

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Concise and descriptive names were then assigned to the themes, ensuring that their content was reflected.

Finally, the findings were documented and detailed. A comprehensive description of each theme was provided, supported by illustrative quotes from the interviews to provide context and depth. The relationships between the themes were explored, demonstrating how they interconnected to form a holistic understanding of the data. Additionally, a discussion of the implications of the findings for the research questions and the broader field of study was included.

RESULTS

The sections that follow present the outcomes of semi-structured interviews with IT experts from PHEIs and a cloud service provider in Palestine.

THEME 1: MCC IMPLEMENTATION IN PHEIS

The first set of interview questions sought to investigate the implementation of MCC in PHEIs. It consisted of open-ended questions designed to capture informants' thoughts freely to assess the level and scope of MCC implementation. The following sections discuss the results.

Implementation level of MCC in PHEIs

The interviewed experts held different opinions on the extent to which MCC is implemented in their respective universities, as shown in Figure 4.

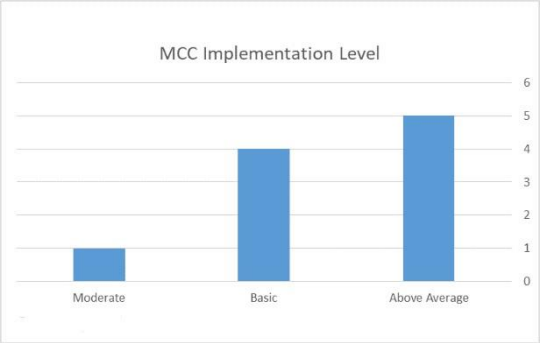

Figure 4. MCC implementation level

Some participants, such as P4, P6, and P8, as well as the cloud service provider (P2), view the implementation as basic. Meanwhile, P1 considers it a moderate level of usage. Conversely, the remaining participants (P3, P5, P7, P9, and P10) believe that their universities have above-average or extensive implementation of MCC.

For example, P5 stated, *"I believe we are at an above-average stage, or let's say two stages away from full implementation."* P8 pointed out, *"We have implemented MCC at a basic level by hosting our entire*

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infrastructure internally in our computer center. While we have limited cloud services, such as Google Applications."

The mobile cloud service model implemented in PHEIs

There are three service models of cloud computing. Universities can use one or more of these service models. The thematic analysis indicated that PHEIs are employing a combination of Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS) models, with SaaS being the most widely implemented. SaaS is mainly utilized for email services, Office 365, and other software requirements. Participants from various universities emphasized the cost-effectiveness and convenience of SaaS, frequently mentioning email and Office 365 as commonly utilized solutions. For example, P4 said, *"We only use SaaS on a small scale, primarily for email services provided to our students and employees."* P6 stated, *"We use more than one model. We mainly use SaaS, and we have PaaS."*

IaaS is used for larger infrastructure requirements, especially for managing large-scale applications and data. For instance, P3 provided specific examples of their use of IaaS, stating, "*In Zoom, we utilize Infrastructure as a Service, or IaaS"* (P3). On the other hand, P9 emphasized the use of both IaaS and SaaS, explaining, *"We have both IaaS and SaaS. Our services from Microsoft are software-based, while from Oracle, they are infrastructure-based."* P10 also declared, *"We utilize SaaS applications, such as Microsoft Office and email services. In addition, we make use of IaaS from Oracle to rent memory, storage, and processors for our applications."* This demonstrates the flexibility and essential role of IaaS in supporting the technological frameworks of the universities.

PaaS is also used, but to a lesser extent than SaaS. This model is chosen because it provides a platform for developing and managing applications without the need to build and maintain the underlying infrastructure. P7 stated, *"In the private cloud, we use PaaS. We have a technology infrastructure in the computer center where we design the software and provide the service. In the public cloud, we take the software from SaaS."*

The mobile cloud deployment model implemented in PHEIs

The NIST recognizes four types of cloud deployment models: public, private, hybrid, and community. Each model is dictated by the infrastructure's location and level of control. Choosing the appropriate deployment model is a vital step in cloud deployment (Rountree & Castrillo, 2014). The findings indicate that universities in Palestine employ a mix of public, private, and hybrid cloud models to meet their diverse operational needs. Many universities in Palestine heavily rely on public cloud services for their operations. This model is preferred for its cost-effectiveness, ease of implementation, and the ability to outsource infrastructure management to external providers. For example, P1 stated,
"For general and short-term needs, we prefer the public cloud due to its cost-effectiveness." While the local cloud service provider (P2) declared, "Palestinian universities utilize certain public cloud services."

On the other hand, some universities implement private cloud solutions to meet their specific and sensitive requirements that demand enhanced control, security, and adherence

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to internal policies. For instance, P1 declared, *"When it comes to customized solutions, we utilize a private cloud."*

Many universities have implemented a hybrid cloud model that combines private and public cloud services. This approach allows them to harness the benefits of both approaches, including flexible scalability, effective cost management, and improved security. For example, P9 revealed, *"We have a hybrid cloud that includes both a public and private cloud. Our cloud services are available to international students. However, locally, we have both on-premise and cloud-based components."* Further, P5 declared, *"Mostly, we employ a hybrid cloud approach. Some of our services are stored internally on our university premises, using our servers, while another portion is hosted on the public cloud."*

Effect of MCC implementation on PHEIs

There is no doubt that the implementation of MCC has a positive impact on the educational process in PHEIs. This is evident from the responses of the interviewed experts. The use of MCC technology had positive effects on university teaching and learning experiences. A thematic analysis of the responses from various participants revealed numerous main themes and related codes that summarize the changes caused by this technology. Table 3 summarizes the themes, codes, and participants that highlighted these effects.

Table 3. Effect of MCC implementation on the academic process

Theme	Code	Participants
Accessibility and Flexibility	Access to educational resources anytime/anywhere	P1, P3, P4, P6, P7, P8, P9
	Improved access during crises	P5, P8, P9
	Flexibility in accessing e-learning platforms	P6, P9
Improved Communication	Enhanced communication between students and teachers	P1, P4, P6, P7, P8, P9
	Improved communication among students	P1, P7, P9
	Better administrative communication	P4, P8, P9
Continuity and Reliability	Continuity of educational services	P3, P5, P9
	Improved data security and reliability	P5
Theme	**Code**	**Participants**
Cost and Resource Efficiency	Reduced costs and infrastructure requirements	P10
	Free services for the educational sector	P10
Enhanced Educational Process	Facilitation of teaching and administrative tasks	P4, P6, P7, P8, P10
	Use of virtual classes	P7, P10
	Use of cloud for exam administration	P8

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Accessibility and Flexibility: One of the most significant impacts of MCC is the increased accessibility and flexibility it provides for students and lecturers. Participants noted that educational resources could now be accessed from anywhere and at any time, offering a level of flexibility previously impossible. For example, P1 emphasized that *"Students now have access to affordable and user-friendly technology, which greatly enhances the e-learning experience."* Similarly, P6 declared, *"There is no doubt that the implementation of MCC has had a positive impact on the educational process. It has facilitated students' access to the necessary educational resources, allowing them to access the Model e-learning platform anytime and from anywhere. Students can also watch their lectures via Zoom, ensuring flexibility. Additionally, they can easily keep track of their lecture schedule, exams, and grades."* This universal access is particularly beneficial during crises, as noted by P5, who mentioned the role of technology in maintaining the educational process during the COVID-19 pandemic and ongoing war. "*It allows us to continue the educational process regardless of the circumstances we face. For example, it has facilitated continuing education during the Corona pandemic and even during times of war"* (P5).

Improved Communication: MCC also improved communication in the university environment. P1
stated that it "*facilitated communication between students, teachers, and among students themselves*," an opinion shared by P4, who emphasized the technology's role in "*improving and facilitating the communication process between students and lecturers*." This enhanced communication also applies to administrative processes, as noted by P9, who stated that *"administrative staff are now able to easily communicate and respond to inquiries even from home.*"

Continuity and Reliability: MCC has enhanced the continuity and reliability of educational services. Both P3 and P9 emphasized the importance of ensuring service continuity regardless of circumstances, with P9 stating, *"MCC helped to ensure business continuity."* P5 highlighted the technology's contribution to improving data security, thereby promoting the sustainability and continuity of educational services. He declared, *"It has enhanced data security, protecting against attacks and ensuring the sustainability and continuity of educational services."*

Cost and Resource Efficiency: The shift to MCC technology also resulted in significant cost and resource efficiency. P10 stated that the use of cloud services reduced the requirement for extensive infrastructure, explaining,*"Before the cloud service, we had to search for numerous servers and infrastructure to complete the educational process. However, with the introduction of cloud services, it has become easier and less expensive. Furthermore, the availability of free services for the education sector has further relieved financial burdens."*

Enhanced Educational Process: Overall, MCC greatly facilitated different aspects of the educational process. P4, P6, and P7 all emphasized how easily teaching and administrative tasks can now be accomplished. The introduction of virtual classes particularly revolutionized education, as pointed out by P7, who stated that*"Virtual classes have not only facilitated the teaching process but also enhanced cooperation among students in solving academic assignments and exchanging experiences."* Additionally, P8 mentioned the utilization of cloud services for exam administration, highlighting the technology's versatility and usefulness in improving the

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educational process. He declared, "*It also helped in streamlining the completion of educational tasks and organizing necessary exams. We utilized Google Forms for these purposes.*"

THEME 2: EXPERTS' VIEWS OF THE FACTORS AFFECTING MCC IMPLEMENTATION IN PHEIS

One of the objectives of this study is to investigate the key factors that influence the implementation of MCC in PHEIs. The TOE framework and DOI model were used to identify the relevant factors.

The identified factors belong to three contexts: technological, organizational, and environmental. The following sections show the results for each context.

Technological context

The technology context describes the qualities of technology that affect its implementation process

(Malik et al., 2021). In this study, the technological context contains four factors (Data security risks, Relative advantages, compatibility, and complexity). The interviewed IT experts were asked about the importance of these factors on MCC implementation in the universities. Table 4 shows the views of the interviewed experts regarding the mentioned factors.

Table 4. Interviewed experts' views on the importance of the technological factors

Factor	Very important	Important	May be important	Not important	Not related
Data security risks	P1, P2, P3, P4, P5, P6, P7, P8, P9, P10	-	-	-	-
Relative advantages	P2, P4, P5, P6, P7, P9	P1, P3, P8, P10	-	-	-
Compatibility	P3, P4, P5, P7, P8, P9, P10	-	P2	P1, P6	-
Complexity	-	P3, P4, P5, P6, P7, P8	P2, P9	P1, P10	-

Data Security Risks: It is evident from Table 4 that all experts agreed that data security risks have a very important effect on the universities' decision to implement MCC. The analysis of participant responses highlighted significant concerns regarding data security risks associated with implementing MCC at universities. Participants uniformly emphasized the critical importance of protecting data confidentiality, integrity, availability, and privacy. They emphasized that strong data security measures are crucial for any technological implementation. Furthermore, they highlighted that the transition to MCC would not be feasible without adequate security protocols. For example, P1 stated, *"Very important in any decision we make is data security ... Without such robust security measures, neither others nor we would be encouraged to use it."*

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The participants also stated that institutions are hesitant to implement MCC fully due to concerns about potential data breaches. They identified risks to data security as significant barriers. P2 expressed this by saying, *"It is crucial to consider the potential risks that universities may face carefully when implementing MCC. This technology can compromise the confidentiality, integrity, availability, and privacy of critical data. Due to concerns regarding data security, some institutions are hesitant to embrace MCC fully, fearing the safety of their valuable information."*

Regarding the impact of data security on universities, several participants emphasized that any breach in data security could have a detrimental impact on the university's reputation. This highlights the broader consequences of data security that extend beyond mere operational disruptions. For example, this could lead to a loss of confidence in the university and cause potential students to be reluctant to study there. For example, P3 stated, "*Data security risks are of utmost importance to us. We highly value the confidentiality of the university's data and strive to maintain its integrity and availability to those who require access to it. Any flaw or compromise in the data can significantly damage the university's reputation, which is why we take great care to ensure its protection."* As for P7, he declared, *"Protecting the confidentiality, integrity, and availability of university data is crucial and should be our top priority. We consider the students' information as our most valuable asset, and any breach of their data will result in a loss of trust in the university. This could potentially damage our institution's reputation."*

These statements demonstrated that the implications of data security extend beyond the university environment. The participants emphasized that potential financial losses, fraudulent activities, and negative impacts on the broader community are critical concerns. P8 declared, *"Financial matters of the university are at stake, and any unauthorized access or hacking can lead to significant problems, including financial losses."* Finally, the participants stressed the necessity of reliable security measures to prevent unauthorized access and data breaches. This indicates that maintaining the integrity and confidentiality of university data is a top priority.

Relative Advantages: Relative advantage refers to the benefits that an institution can obtain by adopting a certain technology, which gives it a competitive edge in its field. Cloud computing usage can bring relative advantages to higher education institutions in a growing field. (Mahmood et al., 2022). The findings of the study revealed a strong consensus on the relative advantages of MCC over traditional IT models. The significant benefits of MCC are seen as crucial factors influencing the decision to implement this technology in universities. Specifically, P2, P4, P5, P6, P7, and P9 deemed it an exceedingly crucial factor, while P1, P3, P8, and P10 acknowledged its importance.

During their interviews, the participants expressed numerous benefits of MCC. However, when explaining its significance, they focused on specific benefits. A major advantage highlighted by participants is the potential for significant cost savings. MCC allows universities to eliminate the need for expensive hardware and infrastructure, resulting in reduced overall expenditures. For example, P3 stated, *"One of the most significant advantages is the potential to reduce costs. By utilizing cloud services, companies can eliminate the need for expensive hardware and infrastructure, resulting in significant savings."*

While P5 declared, *"We choose to use MCC services to reduce costs. Additionally, by utilizing the cloud, the university will not need to purchase software licenses.*"

Improved Performance and Efficiency is another advantage mentioned by some participants. MCC is seen as enhancing performance by providing faster and more reliable access to data and applications. This improvement is crucial for maintaining the operational efficiency and effectiveness of the university. In this regard, P3 stated, "*Mobile cloud services can help improve performance by providing faster and more reliable access to data and applications."* The ability to access data and applications from anywhere, at any time, is a significant advantage of MCC, as reported by participants. This flexibility supports the needs of both students and staff, thereby facilitating a more efficient and effective learning environment. P7 declared, *"MCC enables students and staff to conveniently access educational resources from any location, at any time."*

Moreover, MCC offers enhanced data security for stored data by providing the option to store backup copies in the cloud. This not only provides additional protection but also ensures business continuity, addressing the critical concerns of universities. This was confirmed by P9, who stated, *"We were concerned about ensuring uninterrupted access to our services for students and workers. To achieve this, we decided to implement mobile cloud computing technology. This not only enhanced the security of our stored data but also allowed us to create an additional backup in the cloud. After carefully weighing its benefits against other technologies, we decided to transition to mobile cloud computing."*

On the other hand, the transition to MCC is seen as a way to reduce the workload of the IT team. It simplifies and streamlines IT operations compared to traditional methods, which allows the team to focus on more strategic tasks. As P7 mentioned, *"MCC would simplify and alleviate the IT team's workload compared to traditional methods."*

Compatibility: If a university discovers that MCC technology is technically compatible, it may be more likely to migrate its services to the cloud-computing environment (Bhardwaj et al., 2021). According to this research, most of the experts interviewed (P3, P4, P5, P7, P8, P9, P10) stated that compatibility is a crucial factor that is taken into consideration while deciding to implement MCC. In contrast, only two experts (P1, P6) said that it is not important, and merely one participant (P2) stated that it could be important. Some participating experts linked the extent of the transition to MCC with the level of compatibility with it, such as P9, who said, *"We formed a committee of technology experts before transitioning to mobile cloud computing. Our committee studied compatibility from all aspects to ensure a smooth transition. Once the experts reached a consensus that the switch was feasible, we decided to move forward. We believe that compatibility testing is essential in determining the extent to which we can adopt mobile cloud computing."*

Some mentioned that MCC technologies continue to evolve and that failure to develop the technical infrastructure of the university to keep pace with them will result in additional costs that the university must incur to remain capable of working with the mobile computing environment. For example, P5 stated, *"Technology and standards are constantly evolving, and it is essential to keep up with modernization and development to stay compatible with cloud computing technologies. If the university fails to keep up with these advancements, its technology will become incompatible*

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with cloud technology, leading to higher financial costs. Therefore, compatibility is necessary for modernization, development, and cost reduction." In addition, P10 mentioned, *"Without compatibility, the transition to MCC will not be successful. For instance, if I have licenses for multiple programs and systems and decide to switch to the cloud, I would not want to purchase new licenses. Therefore, I need the MCC to be compatible with my current applications and infrastructure."*

Complexity: The challenge of using technology is often linked to its complexity, which may stem from insufficient technological expertise or difficulty in integration with business operations (Bhardwaj et al., 2021). During the interviews, the participating experts had differing opinions on the significance of the difficulty in using MCC while deciding to implement it. While P3, P4, P5, P6, P7, and P8 considered it important, P2 and P9 believed it to be of some importance, whereas P1 and P10 expressed that it is not a significant factor in the decision-making process. Experts suggested that we are currently in a technology era where even school-aged children can use it with ease. This applies to university communities, including students, lecturers, and administrative staff. The only age group that may find it difficult to adapt to this change are the older individuals who are nearing retirement age. This is because they are more accustomed to traditional work practices. The view of P1 said, *"I do not think it is difficult for anyone, including students and teachers, to use modern technology these days. The only group that may find it challenging is elderly people who are about to retire. However, for the majority of people, using technology is not a big deal. Even children of school age are proficient in using modern technology. We have reached a point where using technology has become easy, and we have become accustomed to it."*

The same interview is mentioned by P6, who stated, *"It is important to consider the complexity of implementing mobile cloud computing, even though the usage of mobile cloud computing is easy."* In addition, P7 declared, *"The challenges of utilizing MCC and the requisite complex skills for students, faculty, and administrative staff are significant considerations. Fortunately, there is increased awareness of these issues. While students have become proficient in the cloud and drive-related topics, they may still require guidance in certain areas."*

According to some experts, students and workers can work with either the traditional system or MCC with no significant difference. However, technical staff in computer centers at universities may face some difficulties at the beginning of implementation because the skills required for MCC differ from traditional skills. This seems clear in what P10 said, *"In the case of regular users, like students and workers, I do not see any significant challenges in utilizing MCC. For instance, if a student intends to work on the educational portal to access services, there will not be any discernible difference between operating on the data center version or the cloud-based version. They would not be able to tell the difference between the two. However, the challenge may arise initially with the IT department or data center staff. The reason behind this is that the cloud requires a different set of skills that they might not have acquired before. However, this issue can be overcome through self-training."*

Organizational context

The impact of an organization's characteristics and resources on implementing innovative decisions is reflected by the organizational context. (Malik et al., 2021). In this study, the organizational context contains only one factor (Top Management Support). The interviewed IT experts were asked about the importance of this factor in MCC

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implementation in the universities. Table 5 shows the results of the views of the interviewed experts regarding the importance of top management support.

Table 5. Interviewed experts' views on the importance of the organizational factors

Factor	Very important	Important	May be important	Not important	Not related
Top management support	P2, P3, P4, P5, P6, P7, P8, P9, P10	P1	-	-	-

Top Management Support: Having top management support is crucial for organizations to adopt new technology. Lack of leadership support decreases the likelihood of innovation adoption (Malik et al., 2021). This study emphasizes the importance of top management support in the decision-making process of PHEIs when it comes to implementing MCC. The experts interviewed unanimously agreed with this view. They explained that this support is essential to cover the financial costs associated with implementing MCC and to manage the risks that may arise from such implementation. This assertion is supported by the answers provided by the experts.

> P3: *"This factor is crucial because, without the support of the senior administration of the university, the implementation of mobile cloud computing services will not succeed. The administration's support is essential as it provides the necessary funds and bears the costs. Additionally, the supporting administration is willing to bear the risks of implementing mobile cloud computing."*
>
> P4: *"For any organization to successfully transform and implement mobile cloud computing, the support of senior management is crucial. This involves not only their willingness to bear the costs of the transformation but also the risks that come with it. Without such support, the chances of success are greatly reduced. Therefore, senior management plays a vital role in making sure that the organization can adapt to the changing times and stay ahead of the competition."*
>
> P5: *"The level of support that the university's top management provides for MCC to offer electronic services is a crucial factor. Without their backing, the implementation of mobile cloud computing and cloud transformation will not be possible. The expenses involved in implementing MCC are high, and there are concerns regarding data security and availability. Therefore, the administration needs to encourage and approve the necessary funding and be willing to take on the risks that come with it, particularly in today's tumultuous political climate."*

Environmental context

Environmental context encompasses external as well as interior variables that influence the operations of a company (Malik et al., 2021). In this study, the environmental context contains two factors (Cloud Service Provider Support and Competition Pressure). The interviewed IT experts were asked about the importance of these factors on MCC implementation in the universities. Table 6 shows the results. The incentives provided by cloud service providers are more influential in the decision to implement MCC than the competitive pressure that universities may face, according to participating experts.

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Cloud Service Provider Support: Organizations that relocate their operations to the cloud frequently rely on providers for assistance. Organizations may have a variety of issues regarding vendor support, including infrastructure adaptation, technical help, training of users, security measures, and data accessibility in the cloud (Bhardwaj et al., 2021). According to this study, most of the experts who participated (P1, P2, P3, P4, P6, P9, and P10) found cloud service provider support to be important, while the remaining three (P5, P7, P8) stated that it might be important.

For example, P9 stated, *"I believe that this factor is crucial. If, for instance, the mobile cloud service provider offers the university free services or a discount on their services, it could encourage them to switch to mobile cloud computing."* P3 declared, *"The assistance of cloud service providers plays a vital role in our operations. Take, for instance, our collaboration with Microsoft. They generously offered us a complimentary service package and extended special features to our student developers, prompting us to quickly and seamlessly transition to their cloud services. Moreover, when Oracle proposed training one of our employees at no cost, we promptly seized the opportunity to acquire their cloud service. This factor has had a favorable effect on our mobile cloud computing implementation. It is a very important factor."*

Some interviewed experts declared that the support of external providers automatically is highly automated and their services are of the highest standard. Hence, support is necessary only with lowerquality service providers. For example, P5 stated, *"The level of incentives, training, and technical support provided by cloud service providers for MCC is a significant consideration, albeit not always necessary … Additionally, as we already rely on external providers, their support is highly automated, and their services are top-notch."*

In general, participants discussed various forms of this support. P2, P4, P5, P7, and P10 underscored the importance of incentives and training that cloud service providers offer, emphasizing their significance. They also highlighted the critical role of reliable technical support provided by these providers. Additionally, P3 and P6 discussed the significance of establishing strong relationships with cloud service providers. P3, in particular, provided specific examples of collaborations with Microsoft and Oracle, illustrating how incentives and support facilitated seamless transitions to their cloud services. Conversely, P1 and P9 examined the impact of limited competition among these providers. Lastly, P8 emphasized that although support from cloud service providers is crucial, cost considerations take priority.

> P1: *"In our country, incentives and technical support are limited. Specifically, Palestine lacks many incentives, making it difficult for companies to offer as much as other countries. Moreover, the number of service providers is small, resulting in a lack of competition."*
>
> P8: *"The level of support offered by cloud service providers in terms of incentives, training, and technical assistance for MCC varies in importance. In this case, we consider it less significant. We do not believe that these incentives will eliminate or reduce the essential costs involved. We view costs as a highly important factor, and therefore, they take precedence in our decision-making process. Consequently, the incentives provided by the cloud service provider will not be a primary consideration for us, particularly in terms of cost reduction."*

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Competition Pressure: Competition is seen to have a favorable effect on IT use and implementation across numerous institutions (Al-Ammary & Saleh, 2021). The thematic analysis revealed different perspectives on how competitive pressure affects the implementation of MCC in PHEIs. Participants P1, P2, P7, and P8 stated that competition pressure played a significant role in the decision to adopt MCC. On the other hand, participants P4, P5, and P9 suggested that competition pressure might have some influence. The remaining experts (P3, P6, and P10) considered competition pressure inconsequential or irrelevant in the choice of using MCC. These experts, who valued competition, justified the fact that universities compete with each other to attract students because they want to ensure student satisfaction. They are concerned that if they fail to meet students' expectations, the students may leave and enroll in rival universities.

An example is P7, who stated, *"One crucial consideration is the pressure that a university may face to implement MCC because of what other universities are doing. The competition amongst universities to draw in a sizable enrolment of students is the cause. Universities thus make an effort to please students with the amenities they offer to draw them to campus."* P8 also announced, *"One very significant element is the pressure that a university faces to implement MCC since other universities have already begun doing so. We do not want our university's student population to decline since we believe that this will have an impact on the number of students who enroll."*

On the other hand, experts who did not consider competitor pressure to be an important factor in implementing MCC gave several justifications for that opinion. For example, P5 explained, *"The amount of pressure the university feels to implement MCC because competing universities have already started using MCC may not be important. Others are unimportant to us. Rather than thinking like rivals, we approach problems as leaders would."* P9 stated, *"We occasionally listen to what staff members and students have to say about how other people are using MCC – or any other technology, for that matter. However, we give greater attention to and care about the technical details than our rivals."* Like P9, P10 stated, *"Competition pressure is irrelevant. We made a purely technical decision and did not think about competing with other colleges."*

Table 6. Interviewed experts' views on the importance of the environmental factors

Factor	Very important	Important	May be important	Not important	Not related
Cloud Service Provider Support	P3, P10	P1, P2, P4, P6, P9	P5, P7, P8	-	-
Competition Pressure	P7, P8	P1, P2	P4, P5, P9	P3, P6	P10

DISCUSSION

The results of the semi-structured interviews conducted with IT experts from PHEIs and a cloud service provider provided important insights into the implementation of MCC in these institutions. These insights shed light on the levels of MCC implementation, the preferred service and deployment models, the effect of implementation on PHEIs, and the influential factors that influence the implementation decision.

The extent of MCC implementation in PHEIs varies, revealing a diverse landscape. Some institutions are fully implementing MCC, while others are still in the early phases of implementation. This difference is consistent with earlier studies, particularly Khayer et al. (2020), who found that the implementation of an information system or technology differs with organization size. Participants P5 and P9 represent institutions that considerably integrated MCC into their operations. In contrast, P8's and P4's basic use of MCC indicates problems, such as insufficient technological infrastructure and financial limitations, as noted by Ibrahim's (2024) results on challenges to cloud usage in educational institutions.

Regarding the mobile cloud service models implemented, PHEIs are using a combination of SaaS, PaaS, and IaaS models, with SaaS being the most widely used. SaaS is mainly utilized for email services and office applications because it is cost-effective and convenient. IaaS, on the other hand, is employed to manage larger infrastructure needs, such as large-scale applications and data. Although less commonly used, PaaS provides a platform for developing and managing applications without the need to maintain the underlying infrastructure. Njenga et al. (2019) also found that SaaS is the most commonly adopted cloud service model.

As for the deployment model, in Palestine, universities utilize a combination of public, private, and hybrid cloud models. Public cloud services are preferred due to their affordability and easy implementation. On the other hand, private clouds are used for more sensitive requirements that require greater control and security. The hybrid cloud model, which combines public and private cloud services, is widely adopted as it allows institutions to strike a balance between scalability, cost management, and security. This approach aligns with the recommendations of Abdel-Basset et al. (2018), who highlighted the significance of choosing suitable deployment models to cater to various operational needs.

Furthermore, the implementation of MCC in PHEIs has had profound positive impacts, notably enhancing accessibility and flexibility for students and lecturers, enabling them to access educational resources anytime and anywhere. This capability has proven crucial during crises like the COVID-19 pandemic, ensuring educational continuity in adverse conditions. This result was confirmed by Alashhab et al. (2021) in their study, which precisely explained the impact of the Covid-19 pandemic on the cloud computing environment.

MCC also enhanced the connected learning environment and administrative efficiency by contributing to improved communication between students, teachers, and administrative staff. Furthermore, it enhanced data security and robust infrastructure, which in turn protected against disruptions and enhanced sustainability, thus ensuring the continuity and reliability of educational services. The implementation of MCC also led to significant cost reductions in universities as well as resource efficiency by reducing the need for extensive physical infrastructure, thus enabling more effective resource allocation. In addition, MCC provided several other comprehensive benefits in higher education contexts, such as transforming educational processes, facilitating the implementation of virtual classrooms, enhancing student collaboration, and simplifying tasks such as exam administration and resource management.

Finally, the successful implementation of MCC in PHEIs depends on various technological, organizational, and environmental factors. These factors were identified using the TOE framework and the DOI model. The findings from interviews with IT experts clarify the important aspects within each context that significantly affect decision-making and implementation processes.

In the technological context, there are data security risks, relative advantages, compatibility, and complexity. Experts consistently highlighted data security as the primary concern, in line with Al-Ramahi et al. (2022) and Bhardwaj et al. (2021), who stated that security is a major issue when implementing cloud computing. The experts stressed the importance of protecting data confidentiality, integrity, and availability. They were concerned about potential data breaches that could damage the institution's reputation and disrupt its operations. This result means that robust security measures are essential for instilling confidence in the implementation of MCC.

Concerning the relative advantages, experts unanimously acknowledged the benefits of MCC, which include cost reduction, improved performance, and enhanced accessibility. This finding is consistent with the research conducted by Badie et al. (2022) and Mahmood et al. (2022). The rationale behind this result is that universities are keen on achieving financial benefits, as they often face budget constraints. Furthermore, they all prefer a more dynamic and efficient learning environment. Enhancing operational efficiency and performance is crucial for ensuring the effective functioning of educational institutions, which heavily rely on seamless access to digital resources.

Compatibility emerged as another significant factor in the implementation of MCC. The findings suggested that it is essential for MCC to align with existing systems and processes to have a smooth transition. This aligns with the research by Bhardwaj et al. (2021), which highlighted the significance of technical compatibility in the successful implementation of new technologies. The ability to integrate MCC with current applications and infrastructure without incurring additional costs is crucial for ensuring a seamless implementation process.

The complexity of using MCC was perceived as a possible obstacle, although experts had differing opinions on this matter. Some believed that the familiarity of the current generation with technology reduces concerns about complexity, while others emphasized the importance of sufficient training and support, especially for IT staff. This is consistent with the findings of Aldahwan and Ramzan (2022), who discovered that complexity hurts cloud adoption in HEIs. However, this contradicts the study conducted by Bhardwaj et al. (2021), which concluded that complexity does not affect the adoption of cloud computing.

In terms of top management support, which is the sole factor in the organizational context, it was recognized as a crucial element in implementing MCC. This is because having the endorsement of leadership is necessary to secure the required financial resources and effectively manage the risks associated with MCC. This conclusion is backed by Mahmood et al. (2022), who argued that leadership support is essential in creating a conducive

environment for technological innovation. Without the commitment of senior management, the chances of achieving successful MCC implementation are significantly reduced.

The environmental context includes support from cloud service providers and competitive pressure. The support from cloud service providers, including incentives, technical assistance, and training, was seen as influential in the decision to implement MCC. This finding is consistent with Bhardwaj et al. (2021), who emphasized the importance of external support from cloud service providers in facilitating cloud adoption. The provision of incentives and reliable technical support can greatly facilitate the transition process and ensure sustained usage of MCC services. On the other hand, experts had different perspectives on the influence of competition pressure on MCC implementation. While some viewed it as a significant motivator, others considered it less relevant. In conclusion, according to the majority of participating experts, competitive pressure is considered an important factor when making decisions related to the implementation of MCC. This aligns with Al-Ammary and Saleh (2021), who discovered that competitive pressure has an impact on cloud computing adoption decisions. Institutions that aim to remain competitive and attract students are more likely to adopt innovative technologies like MCC.

The results of this study closely align with findings from research conducted in other developing countries. For instance, in Iraq, Mahmood et al. (2022) highlighted the impact of data security, top management support, and the relative advantages of implementing cloud computing. Similarly, in Jordan, Al-Ramahi et al. (2022) emphasized the importance of data security. Research in Saudi Arabia by Abdulfattah (2021) also focused on the significance of data security, while Almaiah and AlKhasawneh (2020) examined relative advantages and data security.

In India, Bhardwaj et al. (2021) underscored the importance of cloud service provider support, compatibility, top management support, and data security. Too et al. (2021) addressed top management support in Kenya, whereas Al-Ammary and Saleh (2021) explored relative advantages, data security, top management support, and competitive pressure in Bahrain. Lastly, in Malaysia, Hamed and Preece (2020) discussed relative advantages, compatibility, and cloud service provider support, while Qasem et al. (2020) focused on data security, competitive pressure, compatibility, complexity, and top management support.

In conclusion, this study demonstrated that factors such as data security, relative advantages, compatibility, complexity, top management support, cloud service provider support, and competitor pressure are crucial for the implementation of MCC in PHEIs. The study recommends developing a comprehensive national strategy to promote and sustain the use of MCC, which includes providing the necessary infrastructure and offering technical and financial support to institutions. Furthermore, the government and cloud providers should collaborate to raise awareness of the significance of MCC and to train qualified personnel. Additionally, enacting supportive laws and legislation is essential.

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Despite the importance of these findings, some limitations must be acknowledged. First, geographical constraints may affect the applicability of the results, as they could vary in other countries due to differing infrastructure and economic conditions – particularly since Palestine is a developing country facing the challenges of occupation and resource control. There are also time limitations, as technology evolves rapidly, necessitating periodic updates to this study to keep pace with ongoing changes. Future research could evaluate the impact of policies and procedures implemented to encourage the implementation of MCC, as well as examine the relationship between MCC implementation and academic performance in PHEIs, making a comprehensive evaluation process necessary.

CONCLUSION

The investigation into the implementation of MCC in PHEIs has revealed numerous crucial aspects influencing its use and impact. The extent of MCC implementation varies widely between institutions, reflecting variations in resources, technological infrastructure, and organizational priorities. The study also found a preference for SaaS, IaaS, and hybrid cloud strategies. Each model is chosen according to certain requirements, such as cost-effectiveness, scalability, and security. By combining these concepts, PHEIs can achieve a balance of affordability, control, and flexibility.

Numerous technological factors have an important role in MCC implementation. Data security concerns are of great importance. As a result, important safeguards must be introduced to ensure data confidentiality, integrity, and availability. The relative advantages of MCC, such as cost savings, higher performance, and increased accessibility, are powerful motivators for implementation. They are consistent with the economic and operational objectives of PHEIs. Ensuring compatibility with existing processes and systems is critical for a smooth transition to MCC, lowering costs and addressing integration concerns. However, experts' perceptions of complexity differ, with some emphasizing the significance of adequate training and support for tackling potential challenges.

Organizational factors, specifically top management support, are vital to the successful implementation of MCC. Leadership approval is critical for acquiring financial resources and controlling the risks involved with MCC. The involvement of top management fosters technological innovation, enabling the effective deployment and utilization of MCC services. Environmental factors additionally influence the use of MCC. Cloud service providers provide incentives, technical assistance, and training to help with the transition and long-term usage of MCC services. Adequate support from cloud providers can substantially ease the implementation process and assure long-term success. Furthermore, competitive pressure drives universities to implement novel technologies such as MCC to remain competitive and attract students. This demonstrates the importance of staying ahead in the higher education scene.

Ultimately, the successful implementation of MCC in HEIs depends on controlling these obstacles while leveraging the benefits of technology and organizational support. By addressing the influencing factors and overcoming the barriers, HEIs can improve access to education, productivity, and flexibility. This will put students at the forefront of technological innovation in higher education. Therefore, continued research is needed to realize the benefits of MCC fully and eliminate its limitations.

RESEARCH CONTRIBUTIONS

This study aims to explore the status of MCC implementation in HEIs in Palestine, identifying the technological, organizational, and environmental factors that influence the implementation decision based on the TOE framework and the DOI model. This topic is significant and under-researched in Palestine, particularly as a developing country facing unique challenges related to financial resources, technological infrastructure, and technical expertise, alongside the impact of occupation on the educational process and technological progress in HEIs.

The research utilized a qualitative methodology to gather rich and in-depth data through semi-structured interviews with technology experts in HEIs and a local cloud service provider. All participants have extensive practical experience in implementing MCC and hold positions that enable them to influence the decision-making process regarding the implementation. The interview questions were designed to address the technological, organizational, and environmental aspects influencing MCC implementation, providing a comprehensive understanding of the topic. The analysis was further supported by tools such as NVIVO to ensure the accurate organization of the data and its alignment with the study's objectives.

KEY CONTRIBUTIONS OF THE STUDY

1. **An Analytical Framework Based on Field Data**: The study presents a model illustrating how technological (data security, relative advantages, compatibility, complexity), organizational (top management support), and environmental (cloud service provider support, competitive pressure) factors influence MCC implementation. For instance, the data indicated that top management support, data security, and relative advantages are the most influential factors in the implementation decision.
2. **Practical Recommendations to Enhance Implementation**: Based on the study's findings, recommendations were developed for HEIs and policymakers. HEIs are advised to improve the technical infrastructure, ensure ongoing advanced training for technology personnel, and conduct regular workshops to raise awareness of the importance of MCC implementation. For the government, it is essential to provide financial and political support to create a conducive environment for MCC implementation. Additionally, legislation should be enacted to encourage, facilitate, and protect MCC implementation in educational institutions. For technology providers, offering customized services tailored to

the needs of Palestinian HEIs is crucial. Cloud service providers should also enhance technical support and resources for these institutions to encourage the development and continued use of MCC.

3. **Bridging the Gap in the Literature**: This study makes a qualitative contribution to the literature in Palestine and other developing countries by shedding light on the implementation of MCC in HEIs, a topic that has received limited attention. It enhances understanding of the interactions between technological, organizational, and environmental factors in this unique context.
4. **Practical and Academic Impact:** The results enrich the existing literature and provide a practical framework applicable to HEIs in Palestine and other developing countries facing similar conditions, making the study particularly valuable to practitioners and decision-makers.

LIMITATIONS OF THE STUDY

This study on the implementation of MCC in PHEIs has a few drawbacks. To begin, the study relies mainly on qualitative data gathered through semi-structured interviews with a small number of IT specialists and a single cloud service provider. This may not fully represent the diversity of viewpoints and experiences found at all PHEIs. The sample size is appropriate for qualitative research, but it restricts the findings' generalizability.

Second, because the study focuses on PHEIs, the findings are context-specific and may not be immediately applicable to HEIs in other regions with diverse technology infrastructures, financial resources, and regulatory contexts. The regional limitation limits the wider applicability of the insights reached. Thirdly, the ever-changing nature of cloud technology and the unique challenges that institutions face as a result were not adequately studied. Technological advancements and shifting market dynamics may have an impact on the long-term relevance of the identified drivers and challenges.

Furthermore, the study lacked quantitative measures and statistical analysis, which may have provided more rigorous findings validation. Because no mixed-methods technique was used, the conclusions are primarily based on subjective assessments and interpretations. Finally, using self-reported data from interviews raises the likelihood of bias. Participants may have given socially acceptable responses or had poor recall of previous experiences. This could have an impact on the collected data's correctness and dependability.

Future studies should examine increasing the sample size, including quantitative approaches, and investigating MCC implementation in a larger range of geographical locations to improve the findings' generalizability and robustness.

FUTURE RESEARCH

Future research on MCC implementation in HEIs should delve into several key areas to build on the conclusions of this study. First, expanding the sample size and including a wider variety of PHEIs will offer a more comprehensive understanding of the diverse experiences and challenges faced by different institutions. Additionally, integrating both quantitative and qualitative methods could enhance the robustness and generalizability of the findings.

Moreover, examining the long-term effects of MCC implementation on educational outcomes, student performance, and institutional efficiency will offer valuable insights into the enduring advantages and possible limitations of these technologies. Future research should also investigate the impact of emerging technologies like Artificial Intelligence (AI) and Machine Learning (ML) in enhancing the functionality and effectiveness of MCC within educational environments.

Furthermore, conducting comparative research across various regions and educational systems might help to identify the socioeconomic factors that influence MCC acceptance and implementation. This will aid in the identification of best practices and techniques that may be used in a variety of settings. In addition, studying the impact of laws and regulations, legislation, and sources of funding on MCC implementation might provide information on the outside factors that assist or impede implementation efforts.

Finally, research aimed at developing comprehensive security frameworks and recommendations tailored to the unique demands of educational institutions will address crucial data privacy and security problems. By resolving these issues, future research can help to deepen our understanding of MCC's potential and lead to better implementation techniques in higher education institutions around the world.

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CONFLICT OF INTEREST

The authors declare no conflict of interest regarding the publication of this paper.

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AI tools were utilized only to refine the language and improve the grammatical accuracy of this paper**.**

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APPENDIX A

Studies on the implementation of MCC at the organizational level

No.	Study	Country	Aim	Model	Method	Results	Strength	Weakness
1.	Abdallah et al. (2024)	Palestine	Investigate the primary factors influencing MCC adoption in universities	TAM+DOI+ TOE	Quant.	The influential factors are perceived usefulness, perceived ease of use social influence, facilitating conditions, management support, security and privacy, and service quality	- uses a large sample size (210 participants). - Focuses on a unique and underresearched context (HEIs in Palestine) that faces distinct socioeconomic and political challenges.	- Focusing on a single university. - Targeted solely at the individual level (students and academics). - Neglecting environmental factors.
2.	Najwa et al. (2023)	Indonesia	Investigate the factors of MCC adoption	TAM	Quant.	The influential factors are knowledge sharing, perceived	The research is based on TAM and is supported by additional factors such as "knowledge sharing" and "trust."	- Focusing on a single university. - Targeted solely at the individual level (students).

						usefulness, and attitude	This provides a robust framework for analyzing the factors influencing adoption.	- Only quantitative data and limited variables
3.	Matar et al. (2022)	Jordan	Investigate the factors affecting MCC usage	UTAUT	Quant.	Performance expectancy and facilitating conditions are the main factors affecting MCC use.	- Utilized the UTAUT model, which is recognized for its effectiveness in analyzing behavioral intentions to adopt new technologies. - Highlights a gap that is not well addressed in the existing literature: how the type of work influences the intention to adopt technology.	- Focused exclusively on faculty and staff, excluding other groups such as students or high-level administrators. - Relied entirely on a quantitative approach, limiting the study's ability to gain deep insights through qualitative interviews - Focused on the period of the COVID-19 pandemic.

No.	Study	Country	Aim	Model	Method	Results	Strength	Weakness

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4.	Aldahwan and Ramzan (2022)	Saudi Arabia	Assess major factors contributing to the adoption of community cloud in HEIs	TOE+TAM + DOI+INT	Quant.	- Compatibility, perceived quality of service, technology readiness, and training positively affect adoption. - External support, government readiness, coercive and normative pressures, and organizational culture also play significant roles. - Cost of IT operations, privacy risks, governance loss, and lack of confidentiality hinder adoption.	- A comprehensive theoretical framework where four main theories (TOE, TAM, DOI, INT) were used. - Bridging the knowledge gap in community cloud adoption at the organizational level within HEIs.	- The number of participants or the parties whose opinions were studied was not mentioned. - No details were provided about the method used to select the sample, such as whether it was random, purposive, or stratified.

5.	Mahmood et al. (2022)	Iraq	describe the significant factors that affect cloud computing adoption by HEIs in Iraq	TOE+UTAUT	Quant.	Relative advantage, security concerns, top management support, IT experience, external support, and facilitating conditions have positive effects on cloud computing adoption by HEIs	- A strong and integrated theoretical framework using two theoretical models: the TOE model and the UTAUT model. - A diverse sample includes management staff, faculty, and IT professionals.	- The study was conducted at a single university in Iraq, specifically the University of Mosul. - The study did not include mediating variables that could influence the relationship between the independent and dependent factors, as suggested by the UTAUT model.
6.	Al-Ramahi et al. (2022)	Jordan	Creating a framework that considers the most important elements influencing	TOE+DOI+TAM	Qualitative	The influencing factors are the usage of technology among students and lecturers, spoon-feeding issues, a sense of trust in CSPs, government	- A comprehensive theoretical framework that integrates various theories. - Diversity of research tools (interviews, questionnaires, focus groups, observation).	- The student sample is limited, consisting of only 100 questionnaires, which is small compared to the size of the surveyed universities. - Did not sufficiently address the impact of broader

			CC adoption			assistance, and security and privacy issues.	-Diversity of academic contexts (public and private universities)	government policies or funding strategies on supporting cloud-computing adoption.

No.	Study	Country	Aim	Model	Method	Results	Strength	Weakness
7.	Abdulfattah (2021)	Saudi Arabia	Investigate the factors that influence students' intention to use MCC.	TAM	Quant.	Determinants of intention to use MCC are attitude towards MCC, perceived ease of use, perceived usefulness, social influence, accessibility of technology, individual characteristics, perceived privacy, and security	- Adoption of a scientifically accepted model (TAM). - Provide recommendations to assist decision-makers in enhancing MCC adoption in HEIs.	- The study was limited to a single university. - Limited to the individual level. - Focused only on the three basic factors (ease, perceived usefulness, social impact).

8.	Bhardwaj et al. (2021)	India	Examine the factors that impact CC adoption in HEIs	TAM+TOE+DOI	Quant.	The main factors influencing cloud-computing adoption include government support, vendor support, technology compatibility, technology readiness, senior leadership endorsement, and security concerns.	- The framework combines three main models, ensuring a comprehensive analysis.	- Focused solely on public universities, which limits the generalizability of the findings to private or governmental universities
9.	Too et al. (2021)	Kenya	Find the critical success factors for the adoption of cloud computing in public universities.	International Business Ma-chines(IBM)	Quant.	Management Support, Technical Support, and User Preparedness have significant positive effects on cloud	- is based on an integrated theoretical framework that incorporates organizational, human, and technical factors, enhancing the comprehensiveness of the results.	- investigated only 2 public universities in Kenya. - A limited number of factors.

						computing adoption.		
10.	Al-Ammary and Saleh (2021)	Bahrain	Investigate the critical success factors for implementing CC into HEIs`	TOE+DOI	Quant.	The critical success factors are relative advantage, security, organizational readiness, privacy, vendor lockin, top management support, governance and policies, and Competitive pressure	-A comprehensive analysis of adoption factors using the TOE framework and DOI theory. - Provide practical and straightforward recommendations for the gradual adoption of CC. - Addresses the impact of adoption on digital research and education. - It included both public and private universities, highlighting the	- Lack of detailed solutions to challenges such as security concerns and lock-in with service providers. - The low response rate compared to the surveyed universities affects the comprehensiveness of the results.

							disparities between the two sectors.	

No.	Study	Country	Aim	Model	Method	Results	Strength	Weakness
11.	Almaiah and Al-Khasawneh (2020)	Saudi Arabia	Investigate the main factors that influence the decision to adopt MCC on the university campus	Factors derived from the literature review	Quant.	The most influential determinants of MCC adoption were quality of service, perceived usefulness, perceived ease of use, relative advantage, trust,	- The study offers clear recommendations for cloud providers and policymakers to enhance technology adoption. - The proposed model of MCC adoption included critical factors identified from the literature	- Focused on the technological factors only. - conducted only in the public universities. - limited to academic staff only. - investigated only the academic staff.

						and security and privacy concerns.	review and other new factors	
	Abdulatif and Hamad (2020)	Sudan	Identify the extent and characteristics of CC adoption in HEIs	various factors	Quant.	Usage is weak and the influential factors are a lack of resource requirements and proper infrastructure and, a lack of training opportunities for IT staff on modern systems.	- Highlights the practical realities of technology adoption in resource-limited environments, such as Sudan. - Provides recommendations for improving technical infrastructure and staff training, offering practical solutions that demonstrate a solid understanding of real-world challenges. - Focused on a topic that has not been	- Limited to only 19 respondents. - Lacked sufficient support from strong theoretical frameworks or specific models. - Although security challenges in cloud computing adoption are significant, this topic has not been explored in sufficient depth.

							extensively researched in Sudan.	
12.	Hamed and Preece (2020)	Malaysia	Investigate the factors that affect Google. Cloud Platform Acceptance in HEIs	TAM	Qual.	The critical factors that affect GCP adoption are relative advantage, compatibility, technology readiness, regulatory policy, and service provider support. Psychological commitment, loss aversion, concerns about vendor	- Integrating positive and negative influencing factors to create a comprehensive model. - Provide recommendations to decision-makers to enhance Google Cloud Platform adoption.	- Lack of research on environmental factors, such as government policies. - Focus solely on the managers' perspective. -Limited focus on a single type of cloud service.

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						reliability, and lack of regulatory policy are hindering Google's adoption		

No.	Study	Country	Aim	Model	Method	Results	Strength	Weakness
13.	Qasem et al. (2020)	Malaysia	to develop and test a proposed adoption model and to examine the key factors of CC adoption in EIs	TOE+DOI	Quant.	The influencing factors are: technology readiness, security, competitive pressure, compatibility, complexity, cost saving, top management support	- A powerful model that integrates the TOE framework with DOI theory. - offers actionable recommendations to assist decision-makers in enhancing CC adoption.	- Environmental factors, such as government policies, have not received sufficient attention. - The study primarily focused on decision-makers and did not consider other perspectives, such as

								those of cloud service providers.
14.	Alghushami et al. (2020)	Yemen	Provide a comprehensive model of CC adoption	TOE	Quant.	Relative advantage, reliability, compatibility, security, technology readiness, top management support, regulatory policy, and competitive pressure have positive significant impacts on CC adoption, except tribalism culture with negative significant impact.	- Introduced an extended model of the TOE framework by incorporating culture as a mediating factor, thereby offering a more comprehensive perspective for understanding CC adoption. - A strong and comprehensive representation of the education sector in Yemen. - Provides clear recommendations to decision-makers and technology providers	- Focusing exclusively on decisionmakers in educational institutions while neglecting others, such as cloud service providers, may limit the effectiveness of this approach.

							to enhance the adoption of CC.	
15.	Sharma et al. (2020)	India	Identify and rank critical factors for CC adoption	TOE+ Cost	Mixed	The influencing factors are IT service cost, time to market, financial losses, quality of service, competitive pressure, lower transaction cost, growing competitive pressure, relative advantage, compatibility,	- Using a mixed methodology that combines qualitative and quantitative analysis ensures that the results are comprehensive and based on diverse sources. - The factors are classified into four main criteria (technology, organization, environment, and economy) and ranked	- The qualitative sample was limited to only 13 organizations, a small number for a large country like India, and may not provide sufficient diversity to yield generalizable results. - Although a mixed methodology was employed, the greatest emphasis seems to have been placed on the

						complexity, security, lockin, organization size, top management support, resistance to change, innovativeness, futuristic, organizational readiness.	according to their importance using two different methods (AHP and FAHP), which adds credibility to the results. - Provides clear recommendations to CSPs and users to help them make informed decisions about adopting cloud services.	quantitative analysis (AHP and FAHP) of factor ranking, with relatively little attention given to qualitative analysis. - The role of the regulatory environment and government policies has not been addressed adequately.

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No.	Study	Country	Aim	Model	Method	Results	Strength	Weakness
16.	Isa et al. (2019)	Malaysia	Investigate factors influencing CC adoption in a HEI	TOE+DOI	Qual.	The influencing factors are: relative advantage, cost reduction, ease of use, compatibility, operational requirement, security, sustainability, trialability, complexity, infrastructure readiness, top management, knowledge and IT skillset, financial, CSP, Geographical, Data Privacy, Guideline and Policy, SLA	- Relying on robust theoretical frameworks. - Comprehensive classification of influencing factors.	- Focusing on a single university.

17.	Adam et al. (2019)	Somalia	Propose an enhanced model for CC adoption by HEIs	TOE+DOI	Quant.	The influencing factors are cost saving, relative advantage, compatibility, security, scalability, dependence on external providers, technological readiness, size of HEI, top management, availability of acceptable SLA, pressures of the available cloud provider competitors, promotion & marketing efforts of providers, availability of training, speed of	- The research utilized a strong methodological design by combining two well-known theoretical frameworks: TOE framework and DOI theory. - The research focuses on the Somali environment, a context that is relatively underexplored in the literature on CC adoption.	- The research did not adequately address the challenges specific to the Somali environment, such as political and economic instability, and their impact on CC adoption. - While the environment is one of the pillars of the TOE framework, the impact of government policies on adoption has not been thoroughly analyzed.

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						the available internet & availability of steady electrical supply.		
No.	**Study**	**Country**	**Aim**	**Model**	**Method**	**Results**	**Strength**	**Weakness**
18.	Tom et al. (2019)	Nigeria	Identify the factors that influence the intention to adopt Infrastructure as a Servicebased e-learning in HEIs.	TOE+DOI+ Other factors	Quant.	The significant factors are relative advantage, cost savings, service provider support, and government support.	- Using an integrated theoretical model that combines TOE with DOI provides a robust theoretical framework. The diversity of factors studied included technological, organizational, and environmental aspects. - Provides practical	- Focusing on universities in northern Nigeria limits the generalizability of the results. - The research focused exclusively on university IT managers, potentially overlooking the perspectives of end

							recommendations to improve the adoption of CC in higher education, particularly in developing countries.	users and cloud service providers. - The recommendations were somewhat general and did not guide how to implement the proposed solutions effectively.
19.	Njenga et al. (2019)	Kenya	Identify the factors that hinder the adoption of CC at Universities and constituent colleges in Kenya.	TOE	Quant.	Key Hindering Factors are concerns about the reliability of CSPs and a lack of skills in CC. Also, there are concerns about inadequate support and training from CSPs and government policies on CC, data security, and confidentiality.		

20.	Sabi, Uzoka, Langmia, et al. (2018)	Sub-Saharan Af-rica	Investigate the factors that influence CC adoption, at universities in sub-Saharan Africa.	TAM+DOI+ Other factor	Quant.	Data security, results demonstrability, usefulness, and socio-cultural factors significantly influence CC adoption.		

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APPENDIX B

Interview Protocol

Implementation of Mobile Cloud Computing:

1. Does your university implement Mobile Cloud Computing?

If NO, please go to Part 2. If YES please, continue with the following questions:

2. Could you provide an overview of the current state of Mobile Cloud Computing implementation at your university, including the scope and extent of its use?
3. What are the reasons (primary drivers or motivations) behind implementing Mobile Cloud Computing in your university?

   Probe: What is being accomplished through MCC implementation?
4. What deployment model of Mobile Cloud Computing (Public, Private, community, or Hybrid) has been implemented in your university?

   Probe: Can you explain the reasons for choosing this deployment model?
5. What service model of Mobile Cloud Computing (SaaS, PaaS, and IaaS) has been implemented in your university?

   Probe: Can you explain the reasons for choosing this service model?
6. Could you provide an overview of the Mobile Cloud Computing services and technologies currently implemented at your university?

   Probe: what are their main purposes or applications?
7. How has implementing Mobile Cloud Computing technology influenced teaching and learning experiences on the university campus?

   Probe: what benefits have been realized?

   Probe: How can benefits be maximized?
8. What challenges or barriers, if any, have been encountered while implementing and integrating Mobile Cloud Computing within your university?


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Probe: How have these challenges been addressed?

9. What are the most significant advantages and disadvantages of Mobile Cloud Computing in the university context, both in terms of educational services and administrative operations?
10. Are there specific Mobile Cloud applications or tools that have become essential for students, faculty, or staff?

Probe: Can you describe their impact on the university community?

11. How has the accessibility and availability of educational resources for students and faculty been influenced by the implementation of Mobile Cloud Computing?

Factors Influencing the Implementation of Mobile Cloud Computing:

12. How important are the following factors to the implementation of Mobile Cloud Computing?

Factor	Very important	Important	May be important	Not important	Not relevant
The relative advantage of MCC compared to the previous traditional IT model (reducing the costs, improving performance, accomplishing tasks more quickly, accessing and sharing resources any time and any place, the scalability of resources, etc.)					
The compatibility of MCC with the university's preferred work practice, university's IT infrastructure, its culture and values, and the way the university operates					
The difficulty degree that faces students and staff in using					

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Mobile Cloud Computing, is that it requires complicated skills.					
The dangers the university may face when implementing MCC such as harming the confidentiality, integrity, availability, and privacy of the university's data.					
The extent to which the university's senior management encourages the use of MCC to provide electronic services (allocating sufficient financial and other resources to implement MCC, willingness to take risks associated with implementing MCC.					
The amount of pressure the university feels to implement MCC because competing universities have already started using MCC.					
The amount of incentives, proper training, and technical support for MCC offered by cloud service providers.					

13. Could you explain how the influential factors among the previous ones, affect the implementation of Mobile Cloud Computing?

    Probe: positive or negative effect?

14. In your opinion, what other important matters must be considered when the university intends to implement Mobile Cloud Computing?

    Probe: Can you tell me why?

Part 2: Questions if the university does not implement MCC

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1. Why does your university not use MCC?

Probe: What are the most important obstacles to using MCC? Please give examples.

2. Is your university planning to implement MCC shortly?

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