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Cloud computing virtual learning environment: issues and challenges

Aminah Rezqallah Malkawi, Muhamad Shahbani Abu Bakar, Zulkhairi Md Dahlin
School of Computing, College of Art and Sciences, Universiti Utara Malaysia, Sintok, Malaysia

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ABSTRACT

Cloud computing (CC) is a popular technology that has demonstrated its usefulness and effectiveness across industries and sectors worldwide. As a result, several educational institutions have recently integrated CC into their platforms and systems, including their virtual learning environment (VLE). In order to highlight the issues, challenges, and requirements to be taken into account before implementing CC technology within educational institutions, it is imperative to conduct a study to investigate the level of awareness, knowledge, and acceptance of the targeted users, who are educators, learners, and administrators of higher education institutions (HE). The result of the study highlighted some concerns facing users from 35 different institutions around the kingdom of Saudi Arabia. In addition, results highlighted the users' training, awareness, technology infrastructure, and cultural influences as factors to consider before adopting a sustainable and usable CC-VLE.

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Corresponding Author:

Aminah Rezqallah Malkawi
School of Computing, College of Art and Sciences, Universiti Utara Malaysia
Sintok, 06010 Bukit Kayu Hitam, Kedah, Malaysia
Email: am.malkawi@gmail.com

1. INTRODUCTION

Information and communication technology (ICT) is offering development opportunities within the educational sector; as the glow of various learning terms such as e-learning, distance education, online education, virtual learning environment (VLE), learning management systems (LMS), blended learning, and web-based learning. However, although all these terms guide to a non-traditional platform of instructional delivery, where the internet medium is taking place, they are used alternatively when talking about learning within higher educational institutions (HEI) [1], [2].

The VLE is one of the supportive solutions within the educational sector; VLE platforms are spaces developed to teach groups of learners remotely through online media [3], offering a smoother learning experience supported by several tools [4]. Recently, most HEIs integrated the VLE into their educational system to support learning effectiveness and overcome the old traditional educational platforms' challenges [4]–[6]. Unfortunately, several researchers indicated challenges facing the VLE, such as the lack of training [7]–[9], lack of knowledge sharing and support [7] and managing available resources and costs, along with the needed technicians required for effective VLE management, Previous challenges arose from the unexpected growth of services, users' demands, and networking [10]. However, to enhance the available learning platforms, HEIs are seeking to employ the latest technological advancements [11]. Thus, cloud computing (CC) came to cope with the rising demand for a reliable, higher performance, and cost-effective technology supporting the educational system [10]. Also, CC increases the effectiveness and efficiency of VLE and collaborative learning [7], [12], as gaining knowledge occurs on the cloud instead of the learner's computing devices [8]. Furthermore, CC offers massive data centers to utilize resources between HEIs via hosted applications [7] leading to an

economic level of software and hardware extent involving storage, servers, networks, and applications, anywhere and at any time [13]. CC support users with better performance, availability, scalability, and lower charges for the service with higher features than traditional data centers [10]. CC is becoming a commodity as the four traditional utilities (i.e., electricity, water, telephone, and gas), whereby users can take advantage depending on their needs and pay as they consume [10]. Therefore, researchers divided CC into services and deployment models [14]. Service model layers are infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS) [7], [12]. On the other hand, deployment models are four types: private cloud, public cloud, community cloud, and hybrid cloud [7], [13].

Several studies investigated challenges facing CC adoption, emphasizing the security challenges and ensuring that it is one of the significant factors challenging CC in different sectors [15]–[23]. Such as [23] investigated the adoption within the governmental sector in Saudi Arabia and found that security, single point of failure, and privacy as challenges concerning the proper implementation of cloud computing. Thus, the study proposed a structure for the appropriate adoption and implementation of cloud solutions. Also, Alqoot [18] studied the critical factors influencing the success of CC adoption, finding some elements creating challenges for the institutions. Thus, he recommended ensuring the security infrastructure when integrating cloud computing and considering the technological maturity and the institution's readiness; these could cause financial risks. Moreover, Aldoayan *et al*. [15], highlighted challenges such as cultural influences, academic staff, student experience, financial aspects, and learning resources. Similarly, AlHajri [7] studied the Omani context in adopting technologies and concluded the need for more training while using technology significantly since cultural factors could affect the efficiency of the adoption process. Also, Hofstede [24] emphasized that any system designed for one culture may not be suitable for any other. Thus, there is a need to consider studying the cultural, social, and technological factors before developing the new technology and assessing it to ensure its performance, efficiency, and acceptance [7]. On the other hand, highlighted the lack of guidance and support for cloud users; most users had difficulties keeping up with the new technology, especially with the security and cultural influences stated in the study [4]. Other studies indicated trust as an issue to be identified, as [25] highlighted the trust relations related to the storage, maintenance, and use of student data by the cloud services vendors. Moreover, Chikhaoui [26] stated that law interception, implementation regulation, and data protection are some issues in Saudi Arabia when adopting cloud computing. Furthermore, Table 1 summarizes the main challenges and concerns facing proper CC adoption gathered from several studies among different sectors.

Table 1. Summary of factors challenging the CC adoption

Challenges	[26]	[18]	[19]	[7]	[4]	[27]	[17]	[24]	[28]	[25]	[21]	[15]	[23]	[29]	[16]	[22]	[20]
Cloud computing expertise			✓									✓					
Cultural				✓	✓							✓					
Data concerns			✓					✓		✓					✓		✓
Failure of client-side encryption																	
Financial		✓									✓	✓					✓
Infrastructure readiness		✓															
Integrity									✓								
Interception laws										✓							
Management concerns									✓		✓						
Network performance	✓										✓						✓
Perceived accessibility	✓																
Privacy issues			✓				✓	✓		✓	✓		✓		✓	✓	
Quality of service							✓										
Security issues		✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
Single point of failure													✓				
Sustainability											✓						
Training			✓	✓	✓				✓								
Trust							✓	✓			✓						

CC proved to be a suitable solution for many educational institutions and colleges facing financial issues or issues in dealing with technical complexity [13], [27]. CC is known as 'pay-as-you-go,' meaning that clients only pay for what they use from the cloud service; thus, when service demand is low, there will be a lower operating cost [15], [28]. CC offers many features that encourage organizations to migrate it with their systems and Information technology (IT) resources [13]. For example, software updates and monitoring have become more manageable. Vendors will automatically update systems from their side, replacing any damaged server without any costs, using the cloud server services [13], [29], Besides that, with cloud computing,

monitoring and security happen to be more accessible, as vendors will monitor only one station instead of thousands of PCs owned by HEI, same while testing for any security changes [29].

Moreover, Users can decide on the capacity required that suits the needs of the HEI, depending on the institution's size, funding, and requirements [2]. Thus, users can access resources virtually via the available storage, network, applications, and servers [7], [13]. Furthermore, CC in HEI offers many advantages, such as developing the IT quality and facilitating the competencies of IT while giving the educational admins and managers them to concentrate more on their institution's output, perception, research, and objectives to achieve [30]. Also, it offers a generous scope of sharing learning resources, scientific articles, research papers, and references by taking advantage of CC storage like Google Docs or Dropbox [31].

All of the above create opportunities for HEI to take advantage of the collaborative environment supported by cloud technology and consequently adopt the cloud to be used between different HEIs to share and collaborate. Such an environment could support HEI, students, and academics, in sharing experiences, expertise, and cost, in addition to allowing the development of courses and teaching material to be jointly done between HEIs [15], [32], [33]. Furthermore, encouraging educators to share experiences and adopt new teaching approaches with other academics will help HEIs train either staff or educators. Along with increasing the student's knowledge via using the forums as a discussion and sharing media [15].

Also, it is remarkable to mention the increase of interest in CC use, as according to [34], public cloud services' end-users spending was around $396 billion in 2021, reaching $482 billion in 2022, meaning a growth of 21.7% within one year, predicting an estimated increase in spending by 45% in 2026. Therefore, several studies emphasize the urgency of integrating CC with the educational sector's platforms for a compelling experience [4], [10], [21], [22]. Moreover, CC changed the traditional path to access information and services, as costs are saved and provide more flexibility, reliability, adaptability, optimization of the IT, efficiency, data safety, sustainability, and mobility [7], [35], [36]. Such interest has increased since the COVID-19 pandemic, as it created a dynamic changing environment that led the HEI and educational experts to research more on technologies to adopt as an alternative to traditional teaching platforms for successful outcomes and learning experiences [37]. Primarily since the current VLEs are not functioning and used with all their available features, as some features are either disabled, not used to their full potential, or do not suit the local needs [4], [7], [11].

On the other hand, most of the CC research in the literature is within the business field, not the educational one [38], [39]. Besides, most VLEs in Saudi Arabia lack CC integration [40]. Thus, there is a lack of empirical studies on the adoption process of CC VLE in Saudi Arabia's educational sector [21], [41], [42].

Therefore, this study aims to determine the current status of CC and VLE usage, functionality, and awareness to highlight the challenges and requirements before implementing the CC within HEI in a developing country such as Saudi Arabia. Thus, this study can be used as a preliminary study to develop initial results to help progress in further investigations before conducting a lengthy and expensive full-scale study [43]. In addition, the investigation output and the literature review will all form an input for further research by identifying the challenges and requirements needed to consider before developing an adaptable and acceptable CC VLE platform to be used with the HEI in Saudi Arabia.

2. METHOD

To achieve the aim and objectives of the study, the study uses quantitative research, as the quantitative methods allow the researcher to be objective [44] and draw conclusions based on statistical analysis [45], along with the need to understand the phenomenon [46], which is the case in this research. The researcher adapted an instrument from former studies [7], [13], and later it passed through five experts in the field to review and validate the questions and the translation to Arabic; their feedback took into consideration, and modification took place where needed. Lynn [47] recommended a minimum of five reviewers to validate the instrument before starting the survey process. The study aims to investigate the challenges and concerns of CC-VLE usability. Thus, data was collected from HEIs' users as students, educators, and administrators. A total of 207 participants from 35 different HEIs around Saudi Arabia completed the survey on Google forms. The sample used non-probability sampling, the convenient sampling technique, which is best used for population research [48], as in this research where the scope of the study is HEIs users within the whole country. And responses to the survey depend on the participant's willingness and availability [17].

3. RESULTS AND DISCUSSION

The researcher used the SPSS application to analyze the results in this section. The questions were coded into four main parts, starting with the general information and following questions to investigate the overall awareness, knowledge, and challenges of VLE, CC-VLE, and collaboration within HEIs using CC and VLE. Finally, the survey questions asked participants to rate their understanding or agreement. Following is a summary of the results:

- Most participants used the blackboard platform, known to be used by most HEI in Saudi institutions, whether from governmental or private HEI [40]. Besides, almost 19% of the participants needed to be made aware of the name of the platform they were using within their HEI.
- Roughly 56% of the participants admitted they weren't frequently using all the features offered by their educational platforms. They either don't know they exist or are compelled to use them. They don't spend energy generating new resources to fit the online platform; instead, they leverage existing resources. The outcomes on this issue confirmed the conclusions in [1], where the study found it difficult for educators to provide appropriate materials for the online platform.
- Majority of the participant highlighted the issue of the language used within the platforms. In contrast, only around 9% had no problem with the language used within the platform affecting their acceptance and use of communication tools. Also, most participants need help recording or opening the camera during online sessions. With percentages of 39.3% and 80%, consequently.
- Around 25% do not have a problem chatting with the other gender within the VLE, while the rest highlight it as an issue, agreeing with the [7] study.
- Cultural challenges such as community culture and the digital divide as some regions or people, families, customs, and traditions affecting the efficiency of using the technology, either the VLE or CC was positively highlighted as an issue by the majority of the users with around 90% agreeing totally or partially. Supporting the studies of researchers [7], [13] demonstrating how new technologies like CC in the educational sector were impacted by culture.
- The lack of knowledge about the availability of the most recent technology and its advantages was highlighted by the fact that 46% of the participants said they needed to be made aware of the CC educational programs.
- Roughly 27% of people are unaware or uninformed about integrating CC and educational platforms. Supporting [1] research, each Saudi university has its spearhead system, which requires people to purchase tools and permits. The biggest flaw is that these educational platforms need to be integrated, as doing so would allow them to share course resources and save time and effort.
- Around 80% use cloud storage such as Dropbox, Onedrive, Google Drive, iCloud, and MS LIVE@Edu., in their daily routine to save their educational or personal work, indicating that HEI users use public CC.
- Only 8% of respondents said that the internet connection did not impact the use of CC or educational sites. However, about 48% of respondents said having a good internet connection is extremely difficult, while the remaining respondents said it might occasionally be challenging.
- Only 4% of respondents believed that educators do not require further awareness or training on using all the tools and features of cutting-edge technology like CC or even the VLE. However, evidence that backed up the researchers' conclusions pointed to a need for more instruction, direction, and assistance when utilizing technology [4], [7], [9].
- Around 50% of the participants highlighted that sometimes they face trust issues while saving the data on the CC.
- Finally, the collaboration and sharing of resources between different HEIs was an issue, as 63% do not share collaborative service with other HEI, and around 15% find that working with other academic colleagues in other HEI is not exciting and can be challenging.

4. CONCLUSION

This study highlights the current status, awareness, and challenges facing Saudi Arabian HEIs in adopting CC with their VLE. The study supported the previous studies in the literature and concluded that the HEI needs to consider some requirements before introducing and adopting any trending technology, such as CC. Requirements like users' awareness and training, along with the technology infrastructure such as the internet performance, highlight the cultural requirements and ensure that the technology meets the user's needs. Along with that, for an efficient, usable CC-VLE platform, some issues need to be considered, like a stable, sustainable collaboration system between HEIs to enhance the usability and satisfaction of all users. This research can be used as a preliminary study for any further research before developing an adaptable and usable CC-VLE to be used within the HEI within similar teaching and learning environments.

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BIOGRAPHIES OF AUTHORS



Aminah Rezqallah Malkawi received a bachelor's degree in information technology (computer information systems) in 2006 from Hashimite University, Jordan. Currently, a Ph.D. candidate in information technology at the school of computing at Universiti Utara Malaysia (UUM). She has served within the higher institution's educational sector in Saudi Arabia since 2006, in both governmental and private sectors. She is interested in the technology of the education field and digital technology. She can be contacted at email: am.malkawi@gmail.com.



Muhamad Shahbani Abu Bakar received a Ph.D. in computer science (software engineering), M.Sc. (information technology), and B.Sc. computer science in 1990, 1999, and 2009, respectively. He is an associate professor at the school of computing, Universiti Utara Malaysia. After working as an analyst programmer and system analyst (from 1990-2000) in the private and government sector and as a senior lecturer (from 2000-2017), he has served as director of University Teaching and Learning, Universiti Utara Malaysia since 2018. His research interest includes software engineering, big data, cloud computing, learning analytics, educational technology, data warehouse, and business intelligence. He can be contacted at email: shahbani@uum.edu.my.



Zulkhairi Bin Md Dahlin was born in Malaysia in January 1958. He received his Ph.D. in computer information systems from Aston University, UK, in 2000. He received his M.Sc. and BA. degrees in computer science from Western and Southern Illinois Universities in 1984 and 1983, respectively. Currently, he is a professor of information systems at the University Utara Malaysia. He has published more than 200 articles in reputable journals and presented papers at many international conferences and seminars, including as a keynote and invited speaker. He is the author of a book on implementing information strategy planning in an enterprise. He can be contacted at email: zuldahlim@gmail.com.