

## Investigating the upgrade of IT infrastructure to meet the requirements in case of COVID-19 pandemic by Saudi Universities (Case study: Dar Al Uloom University)



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### ABSTRACT

After the spread of CORONAVIRUS (COVID-19), most of the organizations over the world have been shifted to work online to reduce the infection risk which increased the importance of upgrading the IT (or ICT) infrastructure and its services as the basic level for supporting the online activities and ensuring the quality of these activities. This paper will present an experienced case study focusing on the IT infrastructure requirements in the Saudi universities as a relevant educational sector which affected by the COVID-19 pandemic and shifted to continue the learning and teaching processes online. The success of these processes strongly depends on the IT infrastructure which supports all their activities. For this purpose, an exploratory and analytical study is applied to Dar Al Uloom University as an example for the private universities in Saudi Arabia. The case study focused on the comparison between the before and after situations with collecting some feedback from the stakeholders according to the satisfaction about the IT services after the shifting process. The results have been presented as extracted strengths and recommendations for improving the IT infrastructure and its services by the universities to meet the requirements in the new situation with COVID 19.

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### 1. Introduction

All countries are now focusing on minimizing the negative impact of the COVID-19 pandemic that has affected all vital sectors such as the health sector, economy, industry, and education. The education sector is one of the very sensitive sectors in all the countries because it is related to the human and building his knowledge, skills, and competencies which affects strongly the quality of human resources in every country. Therefore, all the governments over the world countries and higher education institutions launched policies and initiatives to continue teaching and learning activities in this exceptional circumstance and to manage teaching activities, student and teacher loads, the implication for education equity and teaching environment online instead of face-to-face

learning (Zhang et al., 2020; Ali, 2020). This shifting to online educational system faced many difficulties related to IT infrastructure capabilities for supporting the online teaching and learning activities and some literature like Murgatrottd (2020) referred to the weakness of online learning infrastructure besides other related weakness like the information gap, inexperienced teachers, and the complex environment at home (Murgatrottd, 2020).

Saudi Arabia is one of the largest countries in the Arab world with a population bigger than >34 million. Most of the population in the country is in the middle age group of 15–64 which includes the age range of higher education students. KSA includes many higher educational institutions that are categorized as the following:

- 23 Government Universities
- 33 Private Universities and Colleges
- 12 Technical Colleges
- 37 Colleges and Institutes for health
- 18 Primary Teacher's Colleges for men
- 80 Primary Teacher's Colleges for women

From the earlier stage of coronavirus spread, the Saudi government decided a number of policies and

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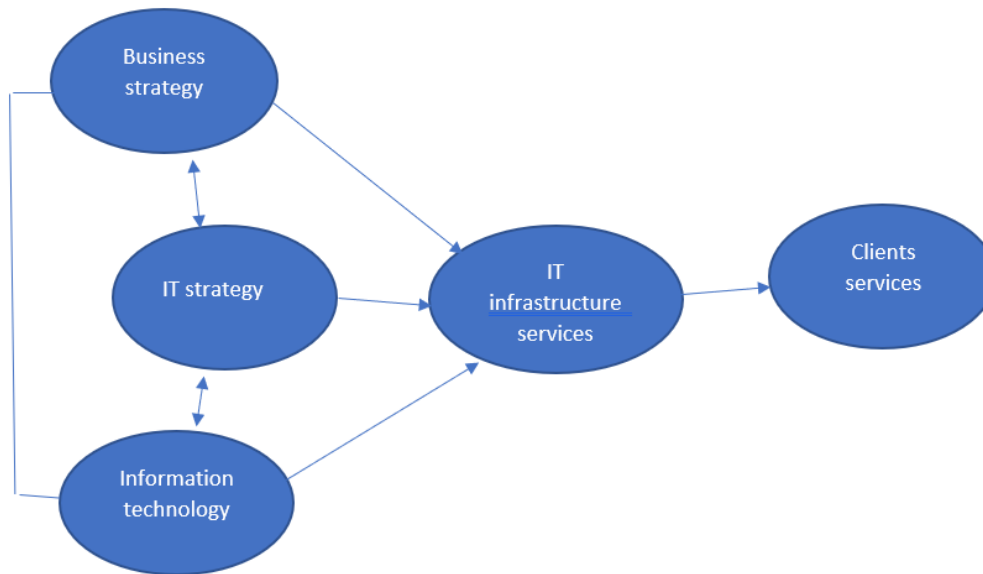
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restrictions to contain the pandemic. The higher education sector was considered clearly among these policies and instructions which directed to continuing the learning and teaching activities online (Tanveer et al., 2020). Considering this unexpected situation, the higher educational institutions were required to prepare their Information and Communication resources to fulfill the requirements of the online learning system. Because these institutions like the universities were prepared to serve partially some online activities through using systems for managing some learning activities and student information The completely online learning

process required an IT infrastructure that suits all the organization's activities and serves the organization to achieve its objectives at the targeted quality level. The quality level of services that the organization can provide to the clients (customers and employees) is directly dependent on the IT infrastructure. This infrastructure should support the organization's business and information systems strategy. Modern information technologies have a powerful impact on business, on IT strategies, and on the services provided to clients (Fig. 1) (Brown et al., 2011).



**Fig. 1:** The dependency of the provided service quality on IT infrastructure

Similarly, the private universities as organizations the quality of their services that are provided to the clients depend on the IT infrastructure which is affected directly on the used technologies. Therefore, this paper will focus on study and analyze the statement of IT or IT infrastructure of one of the private university in the Saudi context before the COVID-19 pandemic and the upgrade that has been done on this infrastructure after spreading the pandemic and how far this was the IT infrastructure upgrade suitable for providing good quality services to the clients to capture the strength and weakness and the improvement chances for the IT infrastructure which lead to improving the quality of the provided services to the clients. The structure of this work will be as the following: The second section will include the background about the IT infrastructure, its components, and the related works. The methodologies will be presented in the third section. The fourth section will discuss the results and the last section will summarize the work.

## 2. Background

After spreading the coronavirus over the world and the shifting from traditional learning or face-to-face learning to online learning, the higher

educational institutions focused more on information and communication technologies which play a relevant role in the success of online learning and teaching processes. Growing the importance of IT infrastructure was especially after increasing the complexity of these processes because of the large number of students and teachers who will work online which required more integration of technology in education.

Many authors identified the main services of IT infrastructure in the organizations which includes software and hardware components as the following (Brown et al., 2011; Alsamawi and Sana'a, 2016; Marakas and O'Brien, 2012):

- Computer hardware platform which includes client devices and servers.
- Operating system platform for personal computers and servers.
- Enterprise software application that supports the core business functions.
- Data management and storage responsible for managing physical and logical data views.
- Networking and telecommunication platforms for data sharing and exchanging.
- Internet platform.
- Consulting and system integration services.

There are many articles that focused on the role and effects of IT in education that will be summarized in [Table 1](#).

**Table 1:** Research articles about the relationship between IT infrastructure and educational institutions

Author	Summary
(Aithal and Aithal, 2019)	The research focused on IT infrastructure as one among the six essential infrastructures that are important for the private universities to have a competitive advantage especially after the advancement of technology which helps the university to build a suitable digital environment for teacher and students
(NRCPGA, 2001; 2002)	Explained the importance of the growing IT capabilities in computation, storage and communication can serve effectively the learning and teaching activities in the universities and will change the knowledge-economy
(Gil-Flores et al., 2017)	Analyzing the role of school IT infrastructure and teacher characteristics to explain IT use in education
(Pelgrum, 2001)	Reviewing the main indicators regarding IT in educational institutions and an exploration of the co-variation between obstacles and contextual factors at the country-level.
(Williamson, 2018)	Focusing on major active data infrastructure in Higher Education and examining the sociotechnical networks of software, programs, standards, dashboards, organization, and visual analytics technologies that constitute the infrastructure, and how these technologies are fused to governmental imperatives of market reform
(Brown et al., 2008)	Describe how to fare the development of IT in South Africa and solving the related issues can positively affect the performance of higher educational institutes there.
(Ngwenyama et al., 2006)	Provides evidence that a complementary relationship between the investments in IT, health, and education can significantly increase development in developing nations.
(Lu et al., 2015)	Investigating the role of IT infrastructure among 2108 educational institutions to study where and play the IT infrastructure positive roles in classrooms and where not
(Egoeze et al., 2014)	Investigating the role of IT infrastructure in 15 Nigerian universities
(Riliskis and Osipov, 2013)	Provides a schema for adjustment of sustainable IT infrastructure for the university needs and focusing on technical readiness and challenges of using cloud technology for university scale IT-infrastructure

Depending on the previous article review about the role of IT or IT infrastructure in educational instructions, the importance of IT infrastructure for the provided services to the clients which explained in the introduction section, and the special needs for upgrade IT infrastructure in light of the COVID-19 pandemic in the universities as one of higher education institutions, the next sections will focus on the exploration of the development of IT infrastructure in Dar Al Uloom University (DAU) in COVID-19 pandemic as a case study.

### 3. Methodology

This paper will use case study method to explore evaluate the readiness and development of the IT infrastructure in Dar al Al Uloom University (DAU) as a sample for private higher education institutions in light of the COVID-19 pandemic to guarantee a good level of online learning and teaching which leads to answering the following research questions:

1. What is the IT infrastructure/facilities provided in DAU?
2. What is the extent that has been done IT infrastructure in DAU to face the new requirements in light of COVID-19?
3. Where is the lack in the current IT infrastructure after the extent because of COVID-19 for a better level of provided services?

The results are expected to guide the universities (especially the private universities) to reform their IT infrastructure to ensure a better level of services for the increased number of online activities in light of COVID-19.

### 3.1. Case study

This paper provides the experience of Dare Al Uloom University (DAU) with the shifting form face to face to fully online learning and teaching processes (Blended Learning for practical lectures) related to the improvement of IT infrastructure as a case study. Dar Al Uloom University was officially established in 2009 in the city of Riyadh, Kingdom of Saudi Arabia, and offers academic programs in bachelor's and master's degrees to graduate competencies that contribute to the achievement of national plans and are in line with the requirements of the labor market. The university includes six colleges, namely Business Administration, Law, Medicine, Dentistry, Architecture and Digital Design, College of Pharmacy, and Applied Medical Sciences. The number of students 2,962 and the number of faculty members 217.

The satisfaction of the beneficiaries of the information technology infrastructure at Dar Al Uloom University was surveyed. The sample included (1440) male students, (1512) female students, (211) faculty members, the total of the sample is (3163). The survey is based on a Likert scale, and the results summarized that male student satisfaction with the IT infrastructure reached 3.4 out of 5, female student satisfaction reached 3.3 out of 5, and faculty satisfaction reached 3.9 out of 5. Based on the results, the IT infrastructure at Dar Al Uloom University is good and needs continuous improvement.

[Table 2](#) will show the case study analysis with focusing on DAU IT infrastructure in normal status, the upgrade after the shifting to online in light of COVID-19, and the priorities of improvement experienced during the 6 months after the shifting.

**Table 2:** Investigation of upgrading IT infrastructure and its services for online learning and teaching processes in light of COVID -19 Pandemic

IT infrastructure components and its services	Normal status	Changes done in light of COVID-19	Priorities of improvement
Servers	DAU has servers central servers that allow sharing Data, application, and peripherals resources between all the stakeholders (students, faculty staff, and administrative employees	The additional server has been installed to increase the availability against the stockholders done for this component after COVID-19 because this kind of changes need to be considered strategically	The server's ability is suitable to serve in the normal situation but in case the shifting into complete online learning and teaching activities the servers faced some problems with a big number of requests that are not required in the normal situation. IT Department in DAU has developed a risk plan and took into consideration upgrading its servers Shifting to online operations requires high speed and memory capabilities for client computers, current hardware is suitable and upgrades od some of them are recommended
Personal computers	DAU provides personal computers and laptops to the faculty staff and the administrative employees	No changes have been done related to these devices	
Application software	DAU has Learning Management System (LMS) which supports the learning and teaching activities like uploading and managing the teaching materials, taking student attendance, E-Assessments, students feedback. Student information system (SIS) which is integrated with LMS provides a wide range of services for the students related to registration, class Schule, exam Schule, storage of student data, grading, Academic Advising, and other services Microsoft Teams, which provides a synchronous communication environment between students and faculty during virtual classes	LMS and SIS were in use for years at Dar Al Uloom University, so the clients did not face any problems using these systems. The Microsoft Teams program has also been added, and all faculty and students have been trained to use it, so the educational process at Dar Al Uloom University did not stop due to the Corona virus.	There is a lack of monitoring capabilities for online exams, which relatively affects the fairness of exams, and this is a general problem and not only in Dar Al Uloom University, and it is recommended to purchase monitoring systems for electronic exams and prevent fraud and impersonation
Database system	DAU has a central relational database management system for storing and retrieving data through the interaction with LMS and SIS functions	No upgrade has been done after COVID-19	N/A
Networks	In a traditional situation, DAU network infrastructure is well organized and managed to support the communications and sharing resources from stockholders (between clients. DAU has a good, structured website which includes many pages that cover the information about the university colleges, personals, activities, and academic procedures	The networks in DAU has been extended by adding new access points to serve the online activities especially when the instructors were teaching from the university at the earlier stage of the pandemic	In spite of expanding of network speed still not enough for completely online processes because of increasing the exchanged data and requests especially during the exams with a large number of students
Website		No update has been done in case COVID-19	The website is advised to obtain more updated information and news, especially regarding the COVID-19 virus.
Video conference networks	DAU began to use the Microsoft team recently.	DAU has focused on training workshops on Microsoft Teams for faculty members from early days, and it is also considered the main application for virtual classes and online meetings and some events have been held using zoom. The team is working very hard after the shifting to online learning to meet the increased IT services through expanding the hardware and software in addition to training the faculty members about the new application and increasing the security grad which became a critical issue in the online environment	N/A
IT team	DAU has an IT department that includes 9 employees responsible for monitoring, controlling, and maintenance all the IT infrastructure components		It is recommended that the support team analyze the requests received by them from the faculty and students and classify them such as frequently asked questions and set up a special page for self-maintenance for technical faults.

Based on the analysis in [Table 2](#), there are some extracted results as strengths and recommendations as follows.

### 3.2. Strengths

DAU in general has a good IT infrastructure that can provide services at a good level to the stakeholders in the normal situation and it began to prepare itself as well as possible from the earlier stage of the COVID-19 pandemic for online learning and teaching activities through:

- Activation of its LMS and SIS applications that support online learning and teaching activities.
- Expanding the capabilities of some of its IT components and adding new tools.
- and providing intensive training for faculty members.

### 4. Recommendations

In spite of the good IT infrastructure services by DAU, there are some recommendations that can be considered for a better situation for the future from DAU as well as the Saudi private (or even public) universities.

As the main recommendation, the universities need to have previously prepared plans to face the disasters or pandemics (like the COVID-19 case) which help for fast and successful shifting to online learning and teaching processes. This plan should be prepared to take into account the feasibility issues through:

- Building collaborative relationships with external IT professionals for exception situation when the internal it team not able to support the increasing requirements.
- Providing continuous training for students and staff about using the learning systems applications including is helpful in case the shifting to online processes.
- Using up-to-date personal computers and operating systems that can serve efficiently in all situations.
- Planning to integrate feasible external solutions which are necessary in case of online exams like the AI base proctoring especially those that are provided in the cloud which increases the quality and reliability of online exams. These can be integrated easily and cheaper for use in exceptional situations like the COVID-19 situation.

### 5. Conclusion

This paper provided DAU case study for one of the higher educational institutions and its experience according to IT infrastructure and its upgrading for online learning and teaching processes in considering COVID-19. The study focused on analyzing the IT infrastructure in a normal situation,

which improvement has been one for the shifting to full online processes and the lacks experienced with the IT infrastructure after the improvement. As result, this work provided several strengths and recommendations that are useful to be considered in the university for planning IT infrastructure to react more efficiently reaction in the exception situations like the COVID-19 pandemic.

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### Compliance with ethical standards

### Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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