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The Impact of Software as a Service on Learning in Libyan Higher Education: An Empirical Study

Salha Aladad[1], Lamia Gweder[2], Abubaker Kashada[3], Awatif Ali Snon[4], Khalid Jumma Bisher[5],

Surman College for Science and Technology [1,2,3,4,5]

salha-alhdad@scst.edu.ly[1], lamiagw@scst.edu.ly2, kashada@scst.edu.ly[3], awatif_ali@scst.edu.ly[4], kalid_bisher@scst.edu.ly[5]

Abstract

Cloud computing has emerged as a significant paradigm in the information technology industry, encompassing three primary service models: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). This study focuses on the SaaS model and its implementation in educational contexts, which necessitates acceptance from all educational stakeholders.

Classified as a case study, the research evaluates the impact of Software as a Service (SaaS) on academic performance in the Computer Department at Surman College of Science and Technology by comparing academic averages before and after the implementation of cloud-based applications. The study employs one questionnaire which target 153 students collecting feedback over multiple academic semesters and comparing it with conventional pedagogical approaches, using SPSS in order to analysis data. This methodology aims to elucidate the requisites for efficacious SaaS implementation and delineate its advantages.

Keywords: *Cloud computing, Iass, Paas, Saas , Computing Resources.*

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Introduction

Higher education institutions must innovate to maintain their competitive edge. Universities are required to provide students with high-quality education to ensure they are adequately prepared for entry into the labor market upon graduation. Consequently, there is a demand for software and applications that can be utilized for educational purposes and to enhance communication among members of educational institutions. These technological resources are often costly, and some universities find them financially prohibitive due to their high price points. As a result, higher education institutions are exploring alternative methods to acquire these software and applications at more affordable rates. Cloud computing presents a potential solution to address this issue[1].

Cloud computing (CC) is regarded as the next generation of computing. It has emerged as the predominant paradigm for resource and service delivery. CC is widely adopted in private and public organizations due to its flexibility, collaboration, cost-effectiveness, and scalability. These attributes render CC essential for users and organizations, including higher education institutions (HEIs)[2]. Higher education institutions (HEIs) are confronting challenges associated with increasing enrollment, growing demands for information technology and infrastructure, quality of educational provision, and the necessity to offer affordable educational services[3, 4].

Resource optimization is a critical consideration for Higher Education Institutions (HEIs). Cloud Computing, as the latest advancement in computing technology within the fourth industrial revolution, has emerged as the primary standard for service and resource delivery. As cloud computing has matured and is being rapidly adopted by numerous HEIs worldwide,

retaining customers of this innovative technology has become a significant challenge for cloud service providers.[5].

The capability of cloud computing to provide on-demand access to software, application platforms, and infrastructure in the form of scalable services has garnered significant interest in academic communities and various industries. This phenomenon can be considered as the realization of a long-held concept known as "Utility Computing." Furthermore, it has emerged in the market with substantial potential to fulfill this vision.[6]. Individuals and organizations can access information and files from any computer system with an internet connection. Typically, according to prominent cloud service providers, such as Microsoft[7].

cloud computing refers to three sets of components that describe many possible combinations for computing. The three primary sets are grouped as: A) essential characteristics, B) service models, and C) deployment models as shown in Table 1 and described below The National Institute of Standards (NIST) definition of cloud computing that follows is the accepted standard: "Cloud computing is a model for enabling ubiquitous, convenient, on demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction."[8].

Table 1(cloud computing components)

CLOUD COMPUTING COMPONENTS

Component	Examples
Essential characteristics	Broad network access, rapid elasticity, measured service, on-demand self-service, and resource pooling.
Service models	Software-as-a-Service (SaaS) Platform-as-a-Service (PaaS) Infrastructure-as-a-Service (IaaS)
Deployment models	Community, public, private, and hybrid.

Cloud computing offers on-demand self-service, rapid elasticity, and measured service, making it a utility rather than a product. It provides software and computing through measurable service over a network or the Internet, with users requesting computing as needed. Resource pooling allows multiple tenants to use the same hardware and software, without knowledge of each other's locations.[9].Service models divide responsibility between user and vendor. In IaaS, vendor provides hardware and operating system, while user manages software applications. PaaS involves setup and management. SaaS, where user has no control, purchases time and space. Higher vendor responsibility reduces user technical demands [8, 9].

SaaS products as mentioned in figure 1, e.g. like database management systems or web application development systems, offer various access options like public, educational, or restricted access, with fee structures ranging from free to premium Some SaaS vendors are offering free or low-cost access for education through four different deployment modes of cloud computing [9].

Fig. 1: saas products

Cloud computing has four different deployment modes as mentioned in figure 2. Those modes are:
Private Cloud is a cloud platform designed for specific clients, managed internally or externally by a third party. Public Cloud is the most common model, providing IaaS, PaaS, and SaaS services. Community Cloud shares an external private cloud with similar clients. Hybrid Cloud combines in-house and third-party providers, with part private and accessible internally and externally.[10]:
.

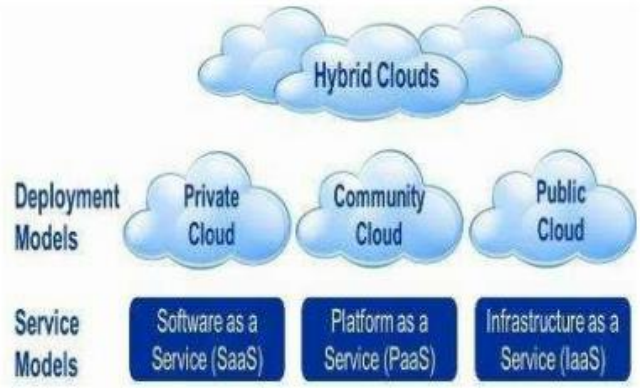

Fig. 2: Cloud Computing Model

Background of Libyan Higher Education

Educational foundations are increasingly utilizing information technology to enhance student learning outcomes and provide faculty access to web programs, as shown in figures 1 and 2.Universities struggle to adopt cloud computing to address processing and storage challenges, aiming to reduce IT complexity and cost by replacing traditional software with internet-based applications for various duties and activities.[11].
Libyan universities utilize Saas vendors like Libyan Spider and Al-Madar, along with international services, for user-friendly, rapid information access across students, faculty, administrative employees, and upper management. see Fig.3.

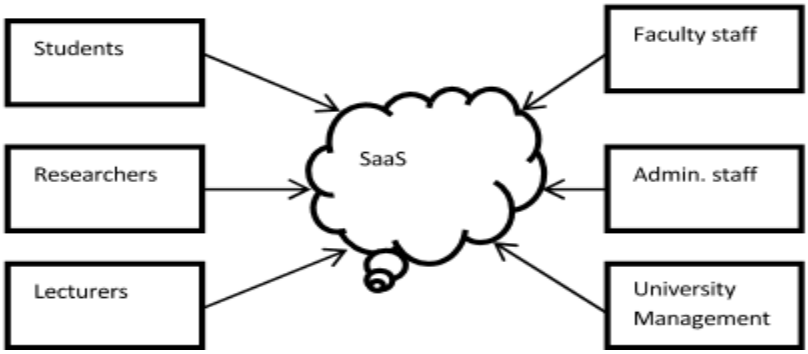

Fig. 3: Typical Users of SaaS in Higher Educational Institutions

SaaS adoption is increasing across industries, including HEIs in Libya, offering various software and applications such as email management, antivirus, middleware, and firewall [12].

Purpose of the Case Study

Software as a Service (SaaS) allows students to access software via the internet, saving time and money on internet usage. This is crucial for higher education, as lifelong learning is now a norm. The case study at Sorman College of Science and Technology in Libya examines SaaS, allowing prospective students to understand the program's availability and recommend improvements. SaaS is a new approach to deliver software, deployed over the internet and used as a service, enhancing the delivery of education and promoting self-learning and self-teaching.

Research Question:

a) **Educational Outcomes:**

Q1a: How does the use of SaaS tools affect student performance and engagement in Libyan higher education?

Q2a: What impact does SaaS have on the quality of teaching and learning experiences in Libyan universities?

b) **Accessibility:**

Q1b: How does SaaS implementation affect students' access to educational resources in Libyan colleges?

Q2b: Does the Sorman College of Science and Technology offer internet and tech support for platform issues?

C) **Security and Privacy:**

Q1c: Does Saas platform provides a high level of security and privacy for users?

Q2c: Do students trust using Saas to manage their accounts and share their educational files on it without any potential risks?

2. Benefits of SaaS in Higher Education

SaaS offers many benefits for higher education institutions and it has the capability to improve the learning process in HEIs. Some of the benefits SaaS offer HEIs include:

2.1 Increased Access to Educational Resources

The cloud enables students, lecturers, and staff to access and complete tasks from anywhere, ensuring data security and timely completion of tasks, thereby meeting deadlines.[13].

2.2 Cost Savings and Efficiency

HEI can save money on software and application purchases and licensing, as well as maintenance costs, which can be used for other crucial tasks.[13][5].

2.3 Collaboration and Communication Enhancement

A community cloud enables easy sharing of knowledge and ideas among students, lecturers, and other institutional cloud users, ensuring they stay current with each other. [14].

Challenges and Limitations of SaaS Implementation

Technical Infrastructure and Connectivity Issues

Offline usage with synchronization opportunities, but risks related to data protection, security, accounts management, dissemination politics, and intellectual property[15].

Data Security and Privacy Concerns

Cloud computing saves crucial data in one place, making it easy for hacking. Educational institutions may prefer hosting data within the institution, but transferring data to a third party in a remote data center presents risks. Contracting multiple providers can minimize risk, and unsolicited advertising is another security issue.[16].

Security engineers must be aware of the diverse methods and security models used by different cloud providers to protect users from unsolicited email or advertising.[17]. A cloud broker smooth connections between different services, allowing organizations to use various services with a secure CSB application. Companies are increasingly adopting cloud-based storage solutions, requiring encryption for data security, a CPU-intensive process.[18].

Faculty and Student Training and Adoption

SaaS offers hosted delivery, but users may not receive the same level of service and support as internal IT or outsourcing. Skilled resources are required for frequent upgrades and initial deployment efforts.[19][20]**.**

Research Methodology

Research Design

The present research paper analysis was based on the one survey targeted students at Surman College of Science and Technology, though questionnaire online, in connection to know opinion of students about utilization of SAAS in education and its effects on their learning. The present research paper is emphases on the Impact of Software as a service on effective in the development the tools of the education, and skills of students[21][22].

Population and Sample

- The main participant's population was based on the students' Surman College of Science and Technology. The present research paper is distributed into one way: -

  The online questionnaire on 18th October 2024, it was conducted among 153 Libyan undergraduate students. The purpose of the survey was to discover the Impact of Software as a service on their learning.

  The questionnaire was validated and tested for reliability using the Person Product Moment Correlation. A Cronbach alpha reliability coefficient (α) of 0.877 was obtained an indication that instrument was reliable for data collection.

Table 1: shows the measurement of honesty and stability using the alphakerobh coefficient of the study variables.

Dimension / factor	Academic performance	accessibility	Security and privacy
Stability	0.847	0.775	0.662
Honest	0.920	0.880	0.813

It is clear from the above table that they are credible and reasonable transactions that reflect the ability of the meter to measure what is designed for it. The stability coefficient for the dimensions as a whole is 0.877(87.7%), and the truthfulness coefficients extracted from the square root function is0.936(93.6%). The dimension academic performance of collage where the stability factor is 0.847(84.7%) and the honest factor 0.920(92%). The accessibility dimension stability is 0.775(77.5%) and truthfulness is 0.88(88%). Finally, the stability factor for security and privacy dimension is 0.662(66.2%) and honest factor 0.813(81.3%), all obtained factors indicate the instrument was reliable for data collection.

Analysis of SaaS Implementation in Libyan Higher Education

Using SaaS in HEIs has several features which help to improve the academic performance. Such as accessibility to Educational Resources, value added services availability and flexible way of the education environment, analysis the data in this paper helps to discuss and analyze the data from the point of view of participants based on descriptive statistics. Where the Spss program was used to analyze data and extract results.

A. Participants Statistics

The following table includes the information about the number of participants that provides the primary information about the impact of Software as a service on Learning in Libyan Higher Education in order to improve academic performance and provide availability and flexibility education. There is one table in below, it is indicating the total number of participants in survey of the use of social SAAS in higher education was 153 including female (104) and male (49) respectively.

Table 2: Participant statistics in the survey of the using Saas in higher education

Gender wise statistics		
	No of participants	**Percent**
Male	104	68%
Female	49	32%
Total	153	100%

B. Descriptive Statistics

The term of descriptive statistics is using in order to the analysis of data that helps describe, reader information about main information. For that, the use of Likert-scales are useful when you are measuring opinions of students about research data includes the number of participants, minimum and maximum frequency are showing that Likert-scales Likert scale measures the extent to which a student agrees or disagrees with the question. The most common scale is 1 to 5. Often the scale will be 1=strongly disagree, 2=disagree, 3=not sure, 4=agree, and 5=strongly agree. The mean refers to average is known by collating of the study data and dividing it by the total amount of data. SD (Standard deviation) The standard deviation is using to measure how

to spread out the data are from the mean; it determines whether the results are negative or positive (acceptable or unacceptable). The following table 3,4,5,6 provide the descriptive statistical information about research variables "Academic Performance", "Accessibility"," Security and Privacy".

academic performance

Table 3: Descriptive statistics of academic performance.

		The use of the college's Saas platform makes access to study materials easier.	Using the College's Saas Platform to Enhance My Educational Experience	Saas Platform: Facilitating Collaboration with Peers in Academic Projects	Saas Platform: Enhancing Time Management for Academic Tasks	Saas Platform: Providing Additional Educational Resources Not Available Traditionally	Using Saas Platform: Enhancing My Ability for Self-Learning
N	Valid	153	153	153	153	153	153
	Missing	1	1	1	1	1	1
Mean		4.03	3.90	3.70	3.66	3.76	3.88
Median		4.00	4.00	4.00	4.00	4.00	4.00
Std. Deviation		.743	.690	.726	.867	.752	.710
Minimum		1	1	1	1	1	1
Maximum		5	5	5	5	5	5

The mean or average values of the "academic performance" variable are showing the outcome that most of the results on average are close to the highest side, i.e., "4" in the given table. Also, when the value of the median approaches the value of the mean, it indicates a balanced distribution of data with few outliers, reflecting stability in the results and overall performance. On the other hand, standard deviation values are also on average between less than 1, which predicts less risk or more acceptance of statements by participants.

Table 4: Descriptive statistics of Accessibility.

Accessibility

		Using Saas Platform in education makes the learning process more flexible and responsive to my needs.	I can easily access the college's Saas Platform services through my personal devices.	The college provides me with the necessary resources to access Saas platform, such as high-speed internet and suitable devices.	I find the necessary technical support when I encounter issues using Saas Platform.	The platform's services are available 24/7 without interruption.	I can easily access the platform's services from outside the college campus.
N	Valid	153	153	153	153	153	153
	Missing	1	1	1	1	1	1
Mean		3.96	3.92	3.12	3.63	3.89	4.05
Median		4.00	4.00	3.00	4.00	4.00	4.00
Std. Deviation		.697	.721	.780	.894	.739	.887
Minimum		1	1	1	1	1	1
Maximum		5	5	5	5	5	5

The mean or average values of the “Accessibility " variable are showing the outcome that most of the results on average are close to the highest side, i.e., “4” in the given table. Also, when the value of the median approaches the value of the mean, it indicates a balanced distribution of data with few outliers, reflecting stability in the results and overall performance. On the other hand, standard deviation values are also on average between less than 1, which predicts less risk or more acceptance of statements by participants.

Table 5: Descriptive statistics of Security and Privacy.

Security and Privacy

	The college provides training and educational videos on how to effectively use the platform.	The college provides sufficient information regarding the security and privacy policies related to the platform.	I feel confident that my files and academic data are well protected when using the platform.	I am concerned about the possibility of my account being hacked on the platform.	I believe that the educational benefits of using the platform outweigh the risks related to security and privacy.	I feel that I have complete control over who can access my files stored on the platform.	I feel relieved when sharing study and project files through the platform.
N Valid	153	153	153	153	153	153	153
Missing	1	1	1	1	1	1	1
Mean	3.89	3.75	3.69	3.18	3.57	3.42	3.79
Median	4.00	4.00	4.00	3.00	4.00	4.00	4.00
Std. Deviation	.768	.693	.765	.994	.817	.871	.731
Minimum	1	1	1	1	1	1	1
Maximum	5	5	5	5	5	5	5

The mean or average values of the “Security and Privacy " variable are showing the outcome that most of the results on average are close to the highest side, i.e., “4” in the given table. Also, when the value of the median approaches the value of the mean, it indicates a balanced distribution of data with few outliers, reflecting stability in the results and overall performance. On the other hand, standard deviation values are also on average between less than 1, which predicts less risk or more acceptance of statements by participants.

Conclusion

In this research paper, we have tried to encapsulate the key verdicts in the impact using Saas platform in Libyan Higher Education (LHE), in relation to cloud computing benefits and student accomplishments by proposing new opportunities for learners. The analysis of the present research paper is indicating that Saas platform is helpful for students to learn and improve academic performance. The research analysis is also signifying that Saas is made education more availability and flexibility for students. Saas makes education more accessible in anytime for many students, additional it provides high Security and Privacy.

This section provides the answers to research questions as per the following:

Q1a: How does the use of SaaS tools affect student performance and engagement in Libyan higher education?

SaaS tools enable students to access educational resources and materials from anywhere, fostering flexible learning environments that can enhance academic performance. These tools enhance student engagement and motivation by providing interactive learning experiences through discussion forums and collaborative projects.

Q2a: What impact does SaaS have on the quality of teaching and learning experiences in Libyan universities?

SaaS tools facilitate the implementation of Learning Management Systems (LMS), improving course material organization, delivery, and student engagement. These tools provide students flexible access to learning materials and virtual classrooms, supporting diverse educational needs. SaaS platforms enhance student-instructor communication, fostering collaboration and active feedback.

Q1b: How does SaaS implementation affect students' access to educational resources in Libyan colleges?

SaaS platforms provide students with 24/7 online access to learning resources for flexible education anywhere with internet.

Q2b: Does the Sorman College of Science and Technology offer internet and tech support for platform issues?

The college provide internet and tech support for online courses and manage electronic accounts. Sorman College of Science and Technology invests in digital learning technologies to improve access to educational resources.

Q1c: Does Saas platform provides a high level of security and privacy for users?

SaaS platforms can offer a high level of security and privacy through various protective measures; their effectiveness largely depends on the implementation of these features by the service provider and the institution's ability to enforce security practices.

Q2c: Do students trust using Saas to manage their accounts and share their educational files on it without any potential risks?

Students have trust in using SaaS platforms to manage their accounts and share educational files. Saas has features that can enhance students' confidence in the safety of their data when using these platforms.

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