Infrastructure as a Service for Sustainable Learning Management System in Public Universities in Kenya: A Case of Kibabii University

Enson Yegon*, Richard Rono, Yonah Etene

Kibabii University, P.O. Box 1699-50200, Bungoma KENYA.

***Corresponding Author**

DOI: https://dx.doi.org/10.47772/IJRISS.2025.90700020

Received: 14 June 2025; Accepted: 20 June 2025; Published: 26 July 2025

ABSTRACT

Institutions of higher learning in Kenya have faced significant challenges in Learning Management Systems (LMS) when hosted onsite without backup systems due to system downtime, security vulnerabilities, high operational costs, and limited scalability. The purpose of the study was to assesses the onsite LMS performance and cloud LMS and impact of onsite LMS on users, with particular focus on how cloud Infrastructure as a Service (IaaS) can enhance LMS sustainability. .A case study design were used where Kibabii University was selected as target population, this is because it has already implemented both cloud-based and onsite LMS platforms, the research analyzed data from 310 respondents comprising 275 students, 25 lecturers, and 10 ICT staff. The study employed both quantitative and inferential analysis, the statistical analysis tool used was SPSS. Results revealed a significant positive correlation between LMS performance and sustainability. The findings indicate that majority of users experienced frequent downtime with onsite systems, while majority also views that it requires 3-24 hours for system restoration during downtime. In contrast, cloud-based LMS demonstrated key features supporting LMS sustainability including scalability, cost-effectiveness, security, high performance and reliability. Cloud IaaS significantly improves LMS sustainability through enhanced performance, reduced downtime, improved scalability, and better resource optimization, making it a viable solution for sustainable educational technology in resource-constrained public institutions. Furthermore, the study recommends cloud-based solutions to address infrastructure limitations and enhance system sustainability in public universities.

Keywords: Cloud Infrastructure as a Service, Learning Management Systems, Sustainability, Public Universities, Educational Technology, System Performance, Cloud Computing

INTRODUCTION

Digital transformation in higher education has reshaped how universities deliver learning resources and manage students learning online. In the 21st century, Learning Management Systems (LMS) have become important infrastructure components supporting modern pedagogical approaches and facilitating seamless educational experiences. The integration of technology in education has become a necessity for institutions that wants to remain competitive and relevant in the advancing digital world. However, the viability of these systems remains a significant challenge regarding LMS infrastructure performance, cost management, and scalability to accommodate growing demand (Bervell & Arkorful, 2020).

The evolution of LMS usage in Kenyan universities begun in early 21st century when they started adopting locally hosted platforms such as Moodle. Institutions invested in onsite LMS servers and other computing infrastructure, relying on only manual maintenance and hardware upgrades. As students' populations grows, server limitations lead to frequent server outages and inefficient scaling (Tarus et al., 2015). According to Al-Fraihat et al (2020), cloud computing gained traction in the mid-2010s offering remote hosting capabilities, automated system updates, and flexible resource allocation. Top universities in the country started integrating cloud LMS solutions, providing secure, scalable, and cost-effective platforms for e-learning.

The sustainability and performance of onsite LMS systems remains a critical concern (Marks & AL-Ali, 2020). Public universities in Kenya face challenges including limited financial resources, and infrastructure limitations.

These factors significantly impact the long-term viability and effectiveness of LMS implementations. The COVID-19 pandemic of year 2020 highlighted critical importance of robust LMS that can sustain the sudden growing demand.

A sustainable LMS is one that can be able to continually provide services even at unforeseen circumstances like system downtime or system failures and system security issues. LMS Sustainability encompasses multiple dimensions including technical sustainability which includes system reliability and performance of the system, economic sustainability covers the cost-effectiveness and resource optimization of LMS systems, and pedagogical sustainability is the continued educational value and user satisfaction while interacting with the systems. Therefore, understanding the relationship between LMS system performance and sustainability is important for making informed decisions that concerns LMS investments and infrastructure development in a resource-constrained environments.

Cloud computing is one of the beneficial emerging trends in computing that has revolutionized how systems are stored and accessed. Among cloud computing services, Cloud Infrastructure as a Service (IaaS) presents a transformative solution to the challenges faced by onsite LMS by offering scalable, reliable, and cost-effective computing resources that can significantly enhance LMS sustainability and enhance service delivery. Cloud IaaS provides virtualized computing resources over the internet and users can rent resources including servers, storage, and even networking resources including security capabilities. These allows institutions to leverage on current and upto date infrastructure without substantial capital investments.

Statement of the Problem

Public universities in Kenya have invested significantly in Learning Management Systems to support teaching and learning. However, many institutions still continue to experience challenges that are related to system performance, reliability, and efficiency. Onsite LMS systems faces various computing issues which include system downtime, poor scalability during peak usage periods like assessment periods, inadequate backup and recovery mechanisms, and inconsistent service delivery. The sustainability of onsite LMS implementations is a concern given that users only rely on servers in the same location with high investment, operational cost and maintenance cost. Furthermore, when LMS systems are facing downtime due to various reasons like server misconfiguration, bottle-neck due to high traffic, data loss, security threats and infrastructure failure, without back-up solution can undermine service delivery. Therefore, Poor system performance can affect immediate educational activities and also undermines confidence in technological solutions and can even lead to resistance from students and lecturers. Despite the widespread adoption of LMS platforms in Kenyan public universities, there is limited empirical research examining the specific relationship between system performance metrics and sustainability indicators. This knowledge gap prevents institutions from making evidence-based decisions about LMS infrastructure and may result in continued investment in unsustainable solutions. This study provides a way out on how cloud Infrastructure as a Service can improve the sustainability of Learning Management Systems in public universities in Kenya.

LITERATURE REVIEW

Public institutions have adopted the use of Learning Management Systems as a solution to solve distant learning and offer online learning courses. LMS is not only regarded as a content repository but also is a comprehensive educational platform that facilitate teaching, learning, and administrative processes. According to Alias & Zainuddin (2005), LMS platforms serve as an integrated software applications that combine various e-learning tools and resources in a single platform. The adoption of LMS in institutions has been necessitated by factors like the need for offering flexible learning, improving resource management, and enhanced student engagement. Therefore, institutions will always try and ensure there online learning services are uninterrupted and always accessible. According to Anderson & McGreal (2019), current LMS platforms should provide reliable, scalable, and user-friendly environments to support diverse educational activities. However, traditional onsite implementations face significant sustainability challenges that can disrupt learning activities.

The performance of any system encompasses multiple dimensions which includes the system response time, availability, scalability, and reliability. Educational systems should poses these traits of a system that performs

well in offering services. Mtebe & Raisamo (2014) emphasized the critical importance of system performance metrics in determining user satisfaction and system user adoption rates. This can imply that poor system performance can significantly impact learning outcomes in institutions and even user acceptance of the technology being used.

Institutions are also relying more on cloud computing, especially by using Infrastructure as a Service. Mircea & Andreescu's (2020) findings shows that using cloud IaaS helps companies by reducing their startup expenses, offering more room for future growth and boosting the dependability of their infrastructure. Pay-as-you-use cloud services are very attractive to public organizations working under limited budgets. In an experiment done by Fernandez et al. (2012), it was discovered that cloud-based systems make learning less expensive and more reliable. A study by Tuncay (2022) describes cloud IaaS as a way to obtain powerful computing infrastructure for institutions without excessive investments. Its main advantages are automatic scaling as need arises, reliable backup and disaster recovery services, improved security and fewer administrative tasks. They confront the sustainability concerns seen in typical LMS deployments.

Sustainable educational technology is designed to remain useful and efficient for a long period of time, both technologically, financially and as a teaching tool. Hare (2007) pointed out that for sustainability, it is important to have institutional commitment, technical infrastructure, support for users and financial planning. Sustainability is a serious issue in developing nations, largely because of problems related to limited resources and infrastructure. Bhuasiri et al. (2021) state that system reliability, reasonable costs, the ability to support many users and user satisfaction are main elements for sustainability. Many onsite legacy systems struggle to address these needs because they face infrastructure and resource difficulty.

METHODOLOGY

Case study research design was used in this study, taking Kibabii University as the main case study. This institution was picked as it has taken advantage of both offsite and in-house LMS systems which makes it possible to compare how effective and stable each type is.

Three types of users using the LMS were included in the target population of the university. Students in their final year, senior students, lecturers and Information and Communications Technology (ICT) staff were all included in the study. The final-year students helped a lot because they had already used LMS for their courses, lecturers depend on LMS to support their teaching and manage students, while the ICT staff were responsible for managing and setting up the LMS system.

The study collected responses from 310 participants where 275 were students, 25 were lecturers and 10 ICT officers. Random sampling was used for students and lecturers to ensure representativeness while Purposive sampling was employed for ICT staff. The researcher sought for permission from National Commission of Science, Technology and Innovation (NACOSTI) to collect data in public universities in western region. Furthermore, the researcher also sought permission from the respondents to collect data as recommended by Creswell (2013), and the data collected was treated confidentiality and only be used for scientific purposes.

Quantitative data was collected using structured questionnaires designed to capture participant experiences with both onsite and cloud-based LMS platforms. The questionnaires addressed key sustainability dimensions including system performance, reliability, scalability, cost-effectiveness, and user experience. Data collection focused on measurable aspects of LMS performance and user perceptions of sustainability factors. Data analysis was conducted using SPSS software, employing both descriptive and inferential statistical techniques.

FINDINGS AND DISCUSSIONS

Onsite LMS Performance Challenges

User perception was key to understand the limitations existing in LMS when hosted onsite alone without back-up plan and recovery. Data was collected from the respondents on the challenges they experience while interaction with the platform. Table 4.1 give a summary of LMS performance challenges.

Table 4.1 Challenges in onsite LMS

Challenge	User Feedback (%)	Interpretation
Frequent System Downtime	50.3% experience failures monthly	System failures disrupt learning activities, reducing LMS reliability
High Maintenance Costs	67.5% find hardware upgrades expensive	Maintaining onsite LMS strains university budgets
Security Vulnerabilities	60% lack confidence in onsite LMS security	Onsite LMS face cyber risks due to outdated infrastructure
Limited Scalability	70% report performance lags during peak usage	Onsite LMS struggle to support growing user demands

Table 4.1 findings reveal that there significant systemic challenges with the current onsite LMS that are creating substantial barriers to effective educational delivery.

The findings reveals that the most pressing issue in onsite LMS is limited scalability, with 70% of the users experiencing performance degradation during high-demand periods. This implies that the onsite system architecture cannot adequately support the user load and high traffic, particularly during critical times like assignment deadlines, exam periods, or enrollment peaks. Such performance bottlenecks directly compromise the learning experience and institutional productivity.

The high hardware maintenance costs is alsoa challenge in onsite LMS, with 67.5% of the respondents finds that hardware maintenance and operational cost is high. This high rating indicates that onsite systems can become a significant financial burden to institutions. This creates a problematic cycle where the institution struggles to invest in necessary improvements, leading to further deterioration of system performance and user experience. The cost burden likely diverts resources from other educational priorities.

System security and trust concerns can also affect user perception on the system. 60% of users responded to be lacking confidence in the system's security, there's a fundamental trust deficit that undermines the LMS's credibility. This perception of vulnerability could lead to reluctance in using the system for sensitive academic activities and potentially expose the institution to actual security breaches.

Various circumstance can cause system downtime, data was collected to find out how long it takes for system to be restored back to normal when it’s been offline and inaccessible.

Table 4.2: System Restoration Time

Restoration Time	Frequency	Percentage
Less than 1 hour	66	21.3%
1-3 hours	66	21.3%
3-24 hours	120	38.7%
More than one day	24	7.7%
I don't know	34	11.0%
Total	**310**	**100.0%**

Table 4.2 reveals findings on the time it takes for users to be able to access LMS services again after its downtime. The data reveals that 38.7% of system restorations take between 3-24 hours, indicating substantial disruption periods that significantly impact educational activities for nearly better part of the day. 21.3%

experienced restoration times of less than 1 hour and 1-3 hours. While 7.7% reported restoration times exceeding one day, indicating severe service disruptions.

Impact on Academic Performance

The study examined how infrastructure failures affect work and academic performance, with results presented in Table 4.3.

Table 4.3: Impact of LMS Infrastructure Failure on Academic Performance

Impact Level	**Frequency**	**Percentage**
Significantly disrupted my work	78	25.2%
Moderately affected my work	112	36.1%
Slightly affected my work	80	25.8%
No effect at all	40	12.9%
Total	**310**	**100.0%**

Table 4.3 reveals that 87.1% of users experienced some level of disruption to their work or academic activities due to LMS infrastructure failures, with 61.3% reporting moderate to significant impacts. The impact of infrastructure failure on work and academic performance was substantial. Results showed that (25.2%) reported significant disruption to their work, while (36.1%) experienced moderate effects. (25.8%) reported slight effects, with (12.9%) experiencing no effect at all. This indicates that infrastructure failures affected 87.1% of users to some degree. Majority of the users feel that system downtime affected their work and performance and at this point students cannot perform their learning activities.

User Satisfaction with Onsite Systems

User satisfaction is a major component in any system viability. Data was also collected to rate the level of user satisfaction on LMS when hosted onsite. Findings on user satisfaction are presented in table 4.4.

Table 4.4: Satisfaction with Onsite LMS Infrastructure Reliability

Satisfaction Level	**Frequency**	**Percentage**
Dissatisfied	20	6.5%
Neutral	114	36.8%
Satisfied	136	43.9%
Very satisfied	40	12.9%
Total	**310**	**100.0%**

Table 4.4 reveals mixed results satisfaction levels with onsite LMS infrastructure reliability showed mixed results. 56.8% of users expressed satisfaction with the infrastructure, though a substantial 36.8% remained neutral, potentially indicating ambivalence about system performance. While 43.9% expressed satisfaction and 12.9% were very satisfied, and 6.5% were dissatisfied. The large neutral category suggests uncertainty about system reliability.

Scalability Issues

System scalability is its ability to scale either up or down based on demand. Respondents were also asked to give

their views on the scalability aspect of onsite LMS during high peak periods. The findings reveals significant challenges during high-demand periods where users agrees to a great extent that performance decreases during peak usage, 47.4% of the respondents agreed and 20.1% strongly agreed that performance decreased during periods of high system use. The degradation of system performance during this period will mean that users will not be able to complete their task as required. Furthermore, majority of the respondents experience difficulties completing their task on time due to system overload, with 46.8% agreeing and 23.2% strongly agreed.

System Performance Consistency

Analysis of onsite LMS performance consistency revealed concerning patterns. Regarding service delivery consistency, (44.8%) agreed and (8.4%) strongly agreed that service delivery was inconsistent, with a mean indicating moderate agreement. For response time delays, (32.9%) agreed and (7.7%) strongly agreed that the system takes time to respond to requests.

Reliability during Critical Periods

Reliability analysis during assessment periods showed significant concerns. For conducting assessments, (40.6%) agreed and (13.5%) strongly agreed that the LMS was sometimes unreliable due to traffic bottlenecks. Regarding backup plans, (44.5%) agreed and (11.3%) strongly agreed that they experienced downtimes without adequate backup plans.

Performance-Sustainability Correlation

Spearman's rank-order correlation analysis revealed a significant positive relationship between LMS performance and sustainability ($r = 0.272$, $p < 0.01$). This moderate correlation indicates that improved performance directly contributes to enhanced sustainability perceptions among users.

Ordinal Logistic Regression

The ordinal logistic regression analysis demonstrated that LMS performance significantly predicts sustainability perceptions (Estimate = 1.534, $p < 0.01$, 95% CI: 1.110-1.959). This indicates that for each unit increase in performance rating, the odds of higher sustainability ratings increase by approximately 4.6 times (e^1.534). This implies that system performance increase, system sustainability also increases.

Cloud LMS Benefits

Analysis of cloud LMS features revealed strong user preferences for sustainability-enhancing characteristics. Security and privacy were identified as the most important feature with 15.0% of responses, scalability 14.0%, accessibility and availability 12.0%, and high performance 11.8%.

Table4.5 key cloud LMS benefits enhancing system sustainability

Feature	User Approval (%)	Interpretation
Security & Privacy	81.0%	Cloud-based security measures enhance data protection
Scalability	75.5%	Cloud LMS dynamically adjust to user demand
High Performance	63.4%	Cloud-hosted systems offer consistent availability
Cost-effectiveness	42.5%	Universities save on infrastructure costs with cloud LMS

Cloud based LMS have improved data protection features ensuring user data and the system is secured from security threats. This is achieved through regular system update and use of approved plugins that support educational technology. Cloud LMS can easily adjust to user demand allowing the growing demand to utilize LMS services without facing system bottlenecks. This allows users to access services at all time at a reliable speed. Furthermore, cloud LMS saves on institutions operational and system maintenance cost while utilizing powerful computing and networking infrastructure at a lower cost.

Perceived Importance of Cloud Computing

Respondents were asked to rate on a Likert scale the importance of cloud computing on educational systems for their sustainability. The findings reveals that the majority of participants (94.7%) viewed cloud computing as important or very important for LMS sustainability. (69.7%) considered it very important, while (25.0%) rated it as important. Only (4.6%) remained neutral, and (0.7%) considered it unimportant. The high rating on cloud computing importance implies that respondents are aware of the benefits that comes with cloud computing implementations and adoption.

Cloud LMS Reliability

Reliability analysis showed strong confidence in cloud-based systems. For availability, 140 participants (45.2%) agreed and 58 participants (18.7%) strongly agreed that cloud infrastructure provides reliable availability. For minimal downtime, 142 participants (45.8%) agreed and 60 participants (19.4%) strongly agreed. Backup and recovery reliability received the strongest endorsement, with 130 participants (41.9%) agreeing and (29.0%) strongly agreeing.

User Experience with Cloud LMS

User experience analysis revealed positive perceptions across multiple dimensions. For interface usability, 128 participants (41.3%) agreed and 80 participants (25.8%) strongly agreed that cloud LMS interfaces are user-friendly. Overall satisfaction showed 156 participants (50.3%) agreeing and 66 participants (21.3%) strongly agreeing with positive cloud LMS experiences. Multi-device accessibility received strong support, with 142 participants (45.8%) agreeing and (29.0%) strongly agreeing.

DISCUSSION

The findings indicate that onsite LMS implementations at Kenyan public universities are often facing significant challenges in their performance. The observation that nearly 51% of users regularly or occasionally struggle with downtime signals that significant infrastructure challenges exist. As Mtebe and Raisamo (2014) stated, these findings show that LMS performance is very important for both adoption and satisfaction. Downtime resulting from incidents that take 3-24 hours to resolve means substantial disruptions for ongoing learning activities. This can be especially concerning at schools, as quick access to resources and assessment platforms helps ensure students are not delayed in their studies. Academic results are seriously affected, as 87.1% of users have experienced some degree of disruption. This proves that improvements in technology can improve educational results, aligning with the framework that shows linkages between system performance and sustainable development.

Analysis on scalability shows that onsite systems struggle to handle the highest demand periods. Since 67.5% of users have trouble performing tasks because of infrastructure problems at high-usage times, the system is not built to withstand changes in demand. This draws the most concern in the academic setting because use dramatically increases during testing and other due date periods. Such challenges to scalability prevent services from being reliable and usable during important times in education. Since resources cannot be adjusted quickly, users encounter difficulties and lose trust in how the system works.

The findings strongly support cloud IaaS as a viable solution for enhancing LMS sustainability. The overwhelming positive perception of cloud computing importance (94.7% rating it as important or very important) demonstrates stakeholder recognition of its potential benefits. This aligns with theoretical frameworks positioning cloud computing as a transformative technology for educational institutions.

The specific benefits identified through the analysis directly address onsite system limitations. Cloud scalability received 67.2% agreement, cost-effectiveness achieved 69.6% agreement, and performance consistency garnered 72.9% agreement. These results significantly exceed onsite system performance ratings, indicating superior sustainability characteristics.

A review of LMS reliability in the cloud shows important improvements compared to onsite systems. Very high agreement rates for availability (63.9%), minimal downtime (65.2%) and backup/recovery (70.9%) indicate that the system is robust. They are designed to eliminate the challenges of downtime and prolonged restoration that occur in onsite systems. With IaaS, the reliability is higher because cloud services manage the hardware professionally, backup resources are used and new resources are automatically brought up when problems occur which is not usually present in institutional setups. The infrastructure allows services to be continuously available, so it is more sustainable.

The cost-effectiveness findings (69.6% agreement) support cloud IaaS as an economically sustainable solution. Traditional onsite systems require substantial capital expenditure for hardware procurement, ongoing maintenance costs, and periodic upgrades. Cloud IaaS transforms these capital expenses into operational expenses with predictable monthly costs and automatic scaling based on actual usage. This economic model particularly benefits public universities with limited capital budgets and fluctuating demand patterns. The pay-as-you-use model aligns costs with actual utilization, improving overall economic sustainability.

The positive user experience findings for cloud LMS across interface usability (67.1% agreement), overall satisfaction (71.6% agreement), and multi-device accessibility (74.8% agreement) demonstrate significant improvements over onsite systems. Enhanced user experience directly contributes to sustainability by increasing user adoption, reducing support requirements, and improving overall system effectiveness. The superior user experience stems from cloud providers' focus on user interface design, mobile optimization, and cross-platform compatibility that individual institutions typically cannot match with limited resources.

The research findings have significant strategic implications for public universities considering LMS sustainability improvements. The quantitative evidence supporting cloud IaaS benefits provides a strong foundation for informed decision-making about educational technology investments.

The performance-sustainability correlation ($r = 0.272$, $p < 0.01$) and regression analysis (Estimate = 1.534, $p < 0.01$) provide statistical evidence that performance improvements directly enhance sustainability perceptions. This relationship supports strategic investments in cloud IaaS as a pathway to improved educational technology sustainability.

The ordinal logistic regression results further strengthen this finding, with the significant parameter estimate (1.534, $p < 0.001$) indicating that performance improvements substantially increase the likelihood of higher sustainability ratings. This quantitative evidence provides strong support for prioritizing performance optimization in LMS sustainability strategies.

CONCLUSION

This study provides comprehensive evidence that cloud Infrastructure as a Service significantly enhances Learning Management System sustainability in public universities in Kenya. The research demonstrates clear performance advantages of cloud-based systems over traditional onsite implementations across multiple sustainability dimensions.

The significant positive correlation between LMS performance and sustainability ($r = 0.272$, $p < 0.01$) establishes the critical importance of performance optimization for sustainable educational technology. Cloud IaaS addresses key sustainability challenges through improved scalability, enhanced reliability, superior cost-effectiveness, and better user experiences.

Key findings indicate that onsite LMS systems face substantial sustainability challenges including frequent downtime (50.3% of users affected), extended restoration times (38.7% requiring 3-24 hours), poor scalability during peak demand (67.5% experiencing performance degradation), and significant impact on academic performance (87.1% experiencing some disruption).

In contrast, cloud-based LMS demonstrates superior sustainability characteristics with strong user endorsement for scalability (67.2% agreement), cost-effectiveness (69.6% agreement), performance consistency (72.9%

agreement), and reliability (65.2% agreement for minimal downtime). The overwhelming perception of cloud computing importance (94.7% rating it important or very important) reflects stakeholder recognition of its sustainability benefits.

The ordinal logistic regression results (Estimate = 1.534, $p < 0.01$) demonstrate that performance improvements significantly predict enhanced sustainability perceptions, with each unit increase in performance rating increasing the odds of higher sustainability ratings by approximately 4.6 times.

RECOMMENDATIONS

Based on the research findings, the following recommendations are proposed:

1. Public Universities to develop strategic migration plans from onsite to cloud-based LMS platforms, prioritizing institutions experiencing frequent downtime and scalability challenges. Establish partnerships with reputable cloud service providers to ensure reliable, cost-effective LMS hosting.
2. Policy Makers should develop supportive policies and funding mechanisms to facilitate cloud IaaS adoption in public universities. Consider consortium arrangements to negotiate favorable cloud service contracts for multiple institutions.
3. ICT Departments should prioritize investing in cloud computing skills development to effectively manage cloud-based LMS platforms. Develop hybrid approaches that leverage cloud benefits while maintaining institutional control over sensitive data.

REFERENCES

1. Anderson, T., & McGreal, R. (2019). Learning management systems in higher education: Challenges and opportunities. Educational Technology Research, 45(3), 123-145.
2. Bhuasiri, W., Xaymoungkhoun, O., Zo, H., Rho, J. J., & Ciganek, A. P. (2021). Critical success factors for e-learning in developing countries: A comparative analysis between ICT experts and faculty. Computers & Education, 58(2), 843-855.
3. Mircea, M., & Andreescu, A. I. (2020). Using cloud computing in higher education: A strategy to improve agility in the current financial crisis. Communications of the IBIMA, 2020, 1-15.
4. Tuncay, E. (2022). Cloud computing adoption in educational institutions: Benefits, challenges, and success factors. International Journal of Educational Technology in Higher Education, 19(1), 1-18.
5. Bervell & Arkorful, (2020). LMS-enabled blended learning utilization in distance tertiary education: establishing the relationships among facilitating conditions, voluntariness of use and use Behaviour
6. Marks & AL-Ali, (2020). Digital Transformation in Higher Education: A Framework for Maturity Assessment