A review on Cloud Computing Issues and Benefits in Higher education institutes

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Abstract: Organizations around the globe especially the ones in emerging countries are stroked with the issue of providing their services to users with the use of information technology. Universities have faced such issue for the provision of services like teaching, research, learning and development activities in line with the quality of education. Major concern for that is the high cost factor of providing and maintaining the required software and hardware for their system. Technology like cloud computing that works on the model of provisioning IT resources on-demand criteria can be adopted to overcome this problem. This technology ensures improved quality of services linked to IT, as the services are available for users whenever and wherever they want at a reduced cost as they have to pay according to pay per use criteria which can be said as utility-based model. Despite of these advantages, challenges that are associated with its adoption in various sectors especially higher education sector have faced hurdles to commit to cloud computing. This paper identifies various issues and benefits of cloud computing in higher education institutes.

IndexTerms **– Cloud computing, Issues, Benefits, Higher education institutes.**

I. INTRODUCTION

As stated by NIST, cloud computing allows extensive, suitable, network access as per demand, to a collective hub of computing resources that are configured (e.g., software, servers, services, networking resources and storage) furthermore, which can be rapidly released and provided with less communication with the provider of the service or management task (Mell and Grance, 2011).Cloud computing being a distributed computing technology enables an environment in which dynamically measurable computing resources including computation power, storage and applications are provided over the internet as a service(Arpaci,2017).

Providing internet-based services even sometimes virtually is a core element of cloud computing. As electronic systems are emerging day by day and paper-based work is declining, virtual technologies and electronics are in high demand. Use of internet-based information technology is a key part of cloud computing. Services are provided often virtually and computer resources are measurable as it is used according to the demand. Cloud computing is getting popular in industry and academic organisations since 2009 (Bouyer and Arasteh, 2014).

In education sector, usage of cloud computing is growing day by day. As cloud computing provides a new horizon of digital learning environment, it is considered as the mechanism of cost optimisation to explore new methods of e-learning. These methods circles around in-classroom activities(Koch *et al.*, 2016). Cloud computing is a handy tool in the field of academia, as it provides dynamic and scalable solutions, supporting the core users like students, faculties, staff, and other branch users to use database, file storage, and other university software's from wherever they want and at any time they need. Hence, various higher education institutes have adopted cloud computing for different reasons that link to cost of hardware accession and maintenance to support teachers and learners to get increased academic output using web 2.0 applications (Okai *et al.*, 2014).

There are various general issues and benefits attached to cloud computing, but this paper talks about the issues and benefits keeping in view higher educational institutes. Furthermore, with research related to the cloud impact in higher educational institutes, this paper talks about benefits in terms of different success stories related to adoption of cloud computing in higher education institutes, which relates to the direction on which other higher educational institutes can march on to adopt this technology and take full advantage of the technology. Additionally, this paper highlights major issues that can act as a barrier for higher education institutes to adopt cloud computing to their educational services.

Software as a service (SaaS) model of cloud allows service providers to provision the stated infrastructure of the cloud such as user's application, storage, servers and etc. Gmail, Google docs and Office365 are the examples, only cloud service providers can manage and control these services (Shahzad *et al.*, 2016). Platform as a service (PaaS) is where the supplier of the service has same control over the services provisioned as in SaaS excluding the application as the customer can control it. In infrastructure as a service (IaaS) supplier can control, manage and provide the stated services also customer is allowed to control the storage, network and operating system as per their need(Joshi, 2015).

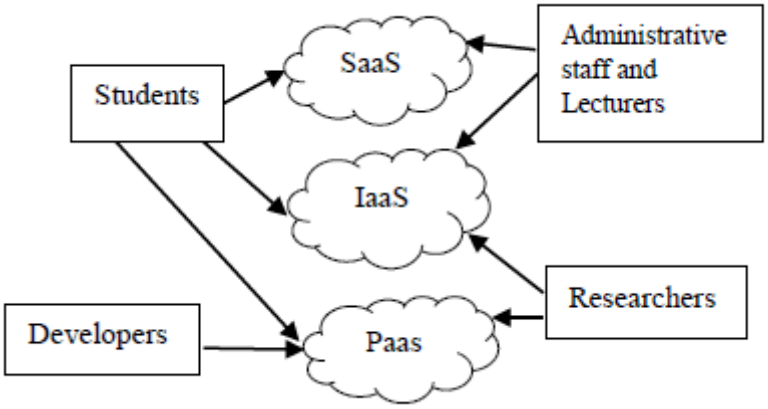

Figure 1 : Service model of cloud computing in a university (Alharthi *et al.*, 2015)

II. ISSUES AND CHALLENGES OF CLOUD COMPUTING IN HIGHER EDUCATION INSTITUTES

Cloud computing adoption exhibits various challenges like selecting a service level outsourcing agreement. Higher learning institutes need to measure the benefits and expense but one of the key factors for their commitment will be their trust level with the chosen model of cloud deployment and the provider of it. Challenges that are faced with cloud computing stress a great impact on decision of migration; hence it is essential to handle such issues and challenges which includes supplier management, negotiation related to contract and training with cautious planning. Various academic institutions are interested in adoption of cloud and some have already outsourced their infrastructure and services to the cloud. University of Alabama at Birmingham shifted its online system to vendor hosting from onsite hosting. Hence through critical planning these issues of cloud computing can be reduced by sharing and collaborative practices. In view of academic institutes to adopt cloud computing, understanding among admin staff, faculty staff, management, users of cloud and cloud service providers is essential (Alkindi, Haynes and Arockiasamy, 2015).

According to Alshwaier (Alshwaier, 2012), Users of universities, institutions and university itself is faced with many different risks in view of cloud computing. Information technology (IT) staff might feel that their job role will be overtaken by the outsourced entity. Institutes are reluctant to shift their critical business data also the services outside to a new unknown location (Alshwaier, 2012).

Use of cloud computing is becoming a basic norm in every type of industry nowadays, with that securing data on cloud is considered as a challenging task. Organizations personal and sensitive data is stored at geographically different cloud platforms and direct control is restricted to the organization. It is very important to check whether the stored data on the remote server is altered or not. Usually the server which stores the data for client is not trusted hence the transferring of data is a complex task (R, 2015).

Security is considered as one of the major concern in the adoption of cloud computing in higher education institutes. Confidentiality, integrity and availability must be tackled efficiently by the cloud providers to ensure that the security requirements of an educational cloud computing systems are satisfied. Requirements like authentication accounts for students, staff members and administration personals to verify and validate each of them by their respective login credentials (username and password). Different encryption models and techniques should be there at the back end to ensure the protection of sensitive data of the institution such as grades, exams, etc. Validation of the information and data is another aspect that needs to be catered using digital signatures and confirmation receipts (Christopher, Temitayo and Comfort, 2014).

Mandatory responsibilities of an organization according to the standards, regulations, specifications and established laws are the aspects of this issue. Data can be placed in different countries and clients are probably unaware of the location of their data storage. When an organization data is in some other country, it is now under the legal, compliance and standards of that regulatory body, hence it raises other security concerns as well. Every country has their own type of security and privacy standards and laws at different levels (i.e., local, national, state, etc.) which makes this issue more complex for higher learning institutes (Islam and Manivannan, 2016).

Critical application like Enterprise level must be available to support and maintenance 24/7, reliable operations in the event of outbreak and failure must be planned in a way that contingency plans come into action smoothly and must begin with minimum disturbance. Every key aspect of reliability must be taken into consideration when engaging with cloud service provider and should be tested with failure drills. With the increase in level of reliability the cost also increases but that is essential to counter the cost and risk of failure (Avram, 2014). Due to breakdown of cloud services, there will be a stoppage in the education services mechanism and flow of the university hence the learning outcome and quality of services provided by the university to their users like students, faculty and administration staff would eventually go down.

Due to the expansion of cloud computing and its diversity it has become a challenging task for an organization to choose a right service provider or supplier. Organizations look at different factors while choosing an appropriate service supplier such as reputation of the company, its market share, resources, also in terms of the count of employees. It is a considered as a very critical procedure to pick a service supplier as if a university chooses a wrong service supplier, the cost of shifting from current service provider to a new one might be expensive as the incompatibility of programs comes with it. Scale down in the employment of customer care, support staff and technical staff might increase with the introduction of cloud services. As most of the official job positions might be filled by the cloud computing service providers. The idea of losing a position in an organisation might factor cloud computing as a key

factor of decrease in job satisfaction, decrease in job satisfaction plays a key role to de-motivate organizations to adopt cloud computing. Change in structure of IT department within an organization, like to downscale it, as most of the IT task is going to be done by the cloud service providers. Cloud computing impact on higher education institutes and in the view of management that how much capable they are to address the IT and administration staff to adopt cloud computing would play a key role in successful achievement or failure of their cloud computing implementation (Rad and Rana, 2017).

Cloud service operates on Hazy Cloud phenomenon, referring to how cloud service is integrated with other applications and software's. Cloud services integration with organizations own established systems needs detail attention and discussion must be done upfront about the requirement of the system to ensure smooth data transfer btw the local applications and cloud. Mostly cloud service level agreements do not cover the performance part and only focused on infrastructure. If a Customer has some specific performance linked requirements for the applications, it must be discussed with the cloud service provider in detail so that it can be made a part of service level agreement. Major hurdle in the adoption and expansion of cloud computing in an organisation is basic performance factor, which includes capacity, availability, or scalability (Almubaddel and Elmogy, 2016).

Consistent flow of connection is considered very critical for universities to provide efficient education services to their users. Unstable internet connect will directly affect the smooth flow of services on cloud. Universities need to make sure that they are subscribed to a reliable provider of the internet so that their network has the capacity to uphold cloud services that they are using. Relying on one internet connection might be a risk; hence universities must have a substitute internet connection so they can shift to the substitute source in case their main internet connection is down (Puthal *et al.*, 2015).

Overall universities face many barriers to adopt cloud computing, but the identified barriers are considered as the most critical ones. If the identified barriers are reduced, this will ensure safe migration of higher education institutes to the cloud technology. Universities need to make sure that they implement cloud computing to at least a small level to experiment and figure out the relevant issues attached to it, before implementing it they need to consult big players in the Information technology field or IT consultants in the market to get a better idea of what can be done to reduce these barriers. They must go into detail considerations of these issues with their cloud service provider and make sure that they are provided with safe transition environment and later if they face any issue, their service provider is there to help them out. Hence selecting a right cloud service provider is a big challenge for the universities, they must take all the factors in account while choosing a service provider such as providers success history, company's number of employers in case if they are capable enough to handle university level issues and the markets review about the company.

There is a hype of security issues attached with every new technology that tries to set a new standard in the market. Universities should consider this issue but they must not let it become a barrier to adopt the respective technology. With the implementation of cloud computing, stage by stage security issues can be resolved and very much possible. Universities should consult data security analyst or IT consultants about resolving security issues, usually techniques like encryption resolves most of the basic security problems. There is still a lot of research deficiency in terms of identifying security issues in cloud computing and there is still need of more research in security issues related to cloud computing in higher education institutes.

Another issue that is considered as very critical in terms of cloud computing adoption is connection bandwidth. Usually Universities of developing countries have faced this issue, consistent flow of connection is really important if universities want to ensure quality and efficient educational services on cloud. Universities must ensure that they have a reliable internet provider and if in case their internet connection is not reliable they must have a backup connection to encounter inconsistency in the connection.

III. BENEFITS OF CLOUD COMPUTING IN HIGHER EDUCATION INSTITUTES

Educational institutions are still striving on possibilities to integrate, rationalise and extemporise the way to manage their resources. Cloud computing can be an opportunity on which an educational institute can rely on all the times to benefit with its reliability, cost-efficiency, flexibility and scalable factor. Cloud computing technology is rapidly evolving service criterion with great importance to the information technology improvement in education sector. Approach to cloud computing relies on many existing technologies like internet, virtualization and so on. Frameworks like Multi-tenant for controlling and managing the services (SAAS, IAAS, DAAS and PAAS) gives a whole new environment to the Edu-cloud users (Rangavittala, Sanjay and Salvi, 2015).

Like other organisations, universities are trying to rely more on information technology (IT). Cloud computing is considered to be an important proposition for small to medium and even start up educational enterprises. University of California (UC) found it attractive when they applied to one of their courses which were focused on SAAS development and deploying. For economic reasons few universities have adopted to cloud computing. The Washington state university has gone through cuts in its expenditure, however it claims that despite the challenging economic environment, cloud computing has enabled them to expand their services which they offer to their students and faculties. Study concluded that important challenges that are faced by higher education institutes to adopt cloud computing are vendor lock-in, privacy in terms of data and security. Researchers have identified the limitation of empirical studies to investigate why the universities are not adopting cloud computing and why the adoption rate is low. Furthermore they have suggested that the future research will be based on examining success factors that would lead to effective adoption of cloud in higher learning institutes (Alharthi *et al.*, 2015).

North Carolina State University adopted cloud computing for the support of their virtual computing lab; hence they saved a lot of cost on software licensing. Lakehead University in Canada and Eastern Washington University have secured a large amount of money when they outsourced their email services. University of Washington also relies on cloud to effectively deploy shared learning for students at various places. Furthermore Pennsylvania State University, United States, relied on cloud based technology for sharing assets and infrastructure for its branches (Okai *et al.*, 2014).

According to the researcher, the benefits of adopting cloud computing has been appreciated by many universities such as University of California and other higher education institutes. Cloud computing provides a platform to universities on which they can focus more on research and teaching activities rather than on difficult configuration of IT and software systems. Cloud solutions provide a backbone for cooperative learning and computer technologies to support methods of instruction in a collaborative way. To ensure the success in e-learning, metrics systems is used by universities to measure the perfection of e-learning solutions that are situated on the cloud (Mircea and Andreescu, 2011).

Demand-based computing approach gives leverage of control on full upfront costs, which cuts down expenditure costs if adopted properly. Cloud computing gives liberty of using resources and storage according to the need of higher education institute and can put it to stop and start according to their requirement. Hence higher education institutes do not need to pay for the services they no longer need or not using. Cloud computing supports the utility-based pricing model of pay-as-you-go. This model allows them to only pay a rental for the services they use(Al-badi, Tarhini and Al-kaaf, 2017). This way the universities can cut down the costs of physical space and overheads linked with the on-going costs.

Higher education institutes do not need to pay for the cost of software updating or licensing as the infrastructure is under the ownership of cloud service providers hence they are responsible for all the maintenance and updating cost. Due to that, institutes that lack in IT or technical staff would be in advantage as cloud computing cuts down the cost of third party repair bills of hardware as less IT staff is needed. North Carolina State University was benefited with savings from their expense as they do not need to pay for the licensing of the software, while on the other side reducing IT technicians and staff from fifteen to only three (Mircea and Andreescu, 2011).

In 1999 Eastern Michigan University (EMU) started using a system that was on web for their online modules information and interfaces for the class. Later they slowly started shifting to cloud based system that supports their software's and resources. With the progress they included more functions and relied greatly on cloud-based technology to fulfil their services for the students. EMU-Online, their application for providing services to the students was implemented in 2010 and by 2014 it became the only source from which students can access course related information. This cloud-based system enabled students to access collaborative documents, discussion portal, email functions, secured web portal and online grade access. It also gave them access to Google cloud suite (Gmail, Google drive, applications). Currently they are working to transition EMU-Online to Canvas, which is their new cloud application which inherits same services with an easier user interface. Researchers have concluded that further work should be done in terms of investigating the factors that affects continued use of cloud computing. Furthermore factors should be identified that would lead to students success in terms of adopting the technology in higher education institutes (Ashtari and Eydgahi, 2017).

Another benefit of cloud computing is that it provides low cost disaster recovery (DR) solutions which lowers the outcome of failure at the affected site. According to the research conducted, cost of running DR services provisioned with public cloud in comparison to privately owned resources, results viewed in increase of cost reductions up to 85% by taking cloud resources into account. Cloud computing reduces the unit cost in view of testing and development environment with increase in effectiveness. Researchers have identified many benefits for the higher education institutes if they adopt cloud computing efficiently and keeping in mind these benefits and success factors, they have recommended that universities should adopt cloud computing for quality of education services and reduced cost or at least start implementing it on a small scale(Al-badi, Tarhini and Al-kaaf, 2017). Universities, with the adoption of cloud computing can shift from capital expenditure to a more optimised operating expenditure model for the development and testing as there is no need to allocate cost for infrastructure, licenses and maintenance.

Cloud computing has benefited many famous higher education institutions worldwide. Cloud computing as a technology can reshape the current educational environment of higher educational institutes in emerging countries if they adopt it. According to the research, Asia Pacific University (APU), Malaysia, had a victorious deployment of cloud computing technology. Hybrid cloud model is being used with a combination of public cloud from vendors of the service and private cloud infrastructure inside the premises for the services to cater up the demand of its users (staff and students). According to the researcher, university saves 95% of total used servers because 10 of the servers were found productive to do the task of 200 servers when they adopted cloud computing technology. Researchers have identified that many universities have found cloud computing very attractive and they are adopting it to improve their quality of education services, but there is still need of a preferred solution that can minimise the issues of cloud computing adoption as much as possible so that users of the higher education institutes can consider migrating to cloud as reliable and safe (Okai *et al.*, 2014). Cloud computing adoption helped Asia pacific university to save additional in view of delivering quality of services to its users but also saves on data storage, secured and high-performance network and reduced amount of carbon footprint.

Cloud computing has various other benefits apart from financials aspects; it provides a wide range of tools and methods for students according to their need and interest. Students can upload, share and access documents and web pages using cloud computing. Cloud services enable students to view and edit documents from anywhere and at any time they want using internet connected device. Cloud computing allows teacher to enter a new horizon of teaching methods with which they can teach in an efficient way, helps them to reduce project management and work pressure. Teachers can also take advantage of all the services that are available to students such as viewing and editing of the document from anywhere and at any time they want using devices such as (mobile phones, laptop, etc) (Al-badi, Tarhini and Al-kaaf, 2017) .

Universities of Qatar, china and turkey are noted to be taking part in activities of cloud academy of IBM. Universities in India are taking advantage of cloud computing big storage to support new research and universities in Vietnam are making use of cloud technology to build applications related to education. Furthermore, universities in china are utilising cloud super computers to study different disease patterns and changing data of climate. It is stated that universities do not need to worry about the system failure due to the backup functionality of cloud technology. According to the research, universities of developing countries do not have enough resources of cloud services while Services situated in developed countries are noted to be cost effective and of advantage in view of development. Researchers pointed out that majority of the research on cloud computing has been done in developed countries rather than developing countries hence more research is required in these countries to identify potential factors that will influence adoption of cloud computing (Karim and Rampersad, 2017).

According to a study on Malaysian higher education sector, relative to public universities users, SAAS cloud computing services became very popular and are widely used. They provisioned SAAS based cloud services to academic staff, students and researchers in the form of online library, learning portals, and access to other teaching material with free storage space from Google and Microsoft SAAS based platforms. This enabled universities to shift their academic tasks to cloud. Researchers have stated that future research should be carried out in terms of user behavioural intention and perceived intention to use technology

to understand the factors that can help in adoption of cloud computing. It is also noted that there is a low rate of cloud computing adoption in universities of emerging countries (Taufiq-Hail, Ibrahim and Yusof, 2017).

Identified benefits from various research papers.

Articles	**Identified benefits of cloud technology in higher education institutes**
Mircea and Andreescu (Mircea and Andreescu, 2011)	• Metrics system on cloud for supporting e-learning solutions. • Reduced cost, as universities no need to pay for software licensing and maintenance.
Okai (Okai *et al.*, 2014)	• Reduced cost in view of software licensing. • Universities can share resources among their different branches at different locations. • Universities can deliver quality of services, save cost with data storage and high-performance network. • Reduced amount of carbon footprint.
Rangavittala, Sanjay and Salvi (Rangavittala, Sanjay and Salvi, 2015)	• Universities can benefit from Cost efficiency and scalable factor of cloud computing technology.
Alharthi (Alharthi *et al.*, 2015)	• Reduced cost and expansion of services to the users of the universities. • Flexible benefits for lecturers to prepare slides, do research through online library and etc.
Srinivasan, Abdul and Vijayakumar (Srinivasan, Abdul and Vijayakumar, 2015)	• Hybrid cloud benefit such as privacy in terms of hiding information.
Karim and Rampersad (Karim and Rampersad, 2017)	• Universities taking advantage of big storage of cloud computing for innovation and new research. • Backup functionality, so universities do not need to worry about system failure.
Taufiq-Hail, Ibrahim and Yusof (Taufiq-Hail, Ibrahim and Yusof, 2017)	• Universities users can benefit from flexible services of cloud computing in view of accessing online library, course material, research work and other tools for development purposes anytime anywhere they want.
Al-badi, Tarhini and Al-kaaf (Al-badi, Tarhini and Al-kaaf, 2017)	• Lecturers can benefit from new teaching methods with reduced project management and work pressure. • Reduced unit cost in terms of testing and development of applications and software. • Utility based pricing model, hence universities do not need to pay for services that are at idle state. • Cloud computing provides low cost disaster recovery solutions to the university at the affected site.

Many different authors have identified the benefits of cloud adoption in higher education institutes. Universities that lack in adoption of cloud computing to their educational services need to realize the success factors of the technology in order to

provide quality of education to their users and to cut down the running cost of their IT infrastructure. Universities of developing countries have significantly low rate of cloud computing adoption, they need to realize that technology like cloud computing can bring a vital boost to their quality of educational services and hence they can compete with other universities around the globe.

Many literatures have supported the fact that universities should adopt cloud computing to benefit their users with efficient educational services to get a better outcome of their actual goal. Apart from financial benefits, universities should focus on the brighter side of the technology like making it easier for their users to do their educational task with flexibility. Furthermore, with Adoption of cloud computing, higher educational institutes can take full advantage of the services that they could not usually provide to their users due to the cost factor attached to it.

IV. CONCLUSION

Cloud computing technology is proven to be very successful for different organizations to enhance their services to their users and make full use of it to cater up the issue of cost and grade up quality of services. Clear advent is there that cloud computing has got attention of many different universities around the globe and proven to be very successful in terms of supporting these universities to provide quality of services to students, faculty, and staff and the community of education itself with cut down in the cost.

There are barriers that are faced by universities to adopt cloud computing to its full effect. These barriers can range from security risks such as availability, confidentiality, authorization, etc to challenges like choosing right service provider, legal and performance issues, job satisfaction issues, bandwidth and etc. Universities are reluctant to adopt cloud computing due to many other issues as well which are still need to be discussed and research about. Major problem encountered in the literature review in context of developing countries educational institutes to adopt cloud computing is the limitation of research and sample data available as adoption of this technology is still in its infancy stage. With provision of a suitable solution to the developing countries higher educational institutes for implementing the architecture of cloud computing with reduced issues and challenges can make a better transition for the university level users to the cloud.

It is evident that many famous universities in developed countries have adopted cloud computing to provide quality of education to their respective users, and universities that lack in adopting the technology need to realise the benefits of cloud computing in terms of cost, quality of education and other successful factors keeping in view other higher education institutes that are benefiting from cloud computing and its services. It is very important for higher education institutes in developing countries to adopt technology like cloud computing in their educational practices to compete and survive in the era of evolving technologies. Future research should be based on individual's perception such as users of the higher education institutes about accepting cloud computing in their educational work practice, as users like students, faculty and administration staff plays a vital role in acceptance of the technology.

REFERENCES

1) Al-badi, A., Tarhini, A. and Al-kaaf, W. (2017) 'Financial Incentives for Adopting Cloud Computing in Higher Educational Institutions', 13(4), pp. 162–174. doi: 10.5539/ass.v13n4p162.
2) Alharthi, A. *et al.* (2015) 'An Overview of Cloud Services Adoption Challenges in Higher Education Institutions', *Proceedings of the 2nd International Workshop on Emerging Software as a Service and Analytics*, pp. 102–109. doi: 10.5220/0005529701020109.
3) Alkindi, Z. S., Haynes, J. and Arockiasamy, S. (2015) 'A Conceptual Architectural Framework of Cloud Computing for Higher Educational Institutions in the Sultanate of Oman', 6(9), pp. 482–487.
4) Almubaddel, M. and Elmogy, A. M. (2016) 'Cloud Computing Antecedents, Challenges, and Directions', *Proceedings of the International Conference on Internet of things and Cloud Computing - ICC '16*, pp. 1–5. doi: 10.1145/2896387.2896401.
5) Alshwaier, A. (2012) 'A New Trend for E-Learning in KSA Using Educational Clouds', *Advanced Computing: An International Journal*, 3(1), pp. 81–97. doi: 10.5121/acij.2012.3107.
6) Arpaci, I. (2017) 'Antecedents and consequences of cloud computing adoption in education to achieve knowledge management', *Computers in Human Behavior*. Elsevier Ltd, 70, pp. 382–390. doi: 10.1016/j.chb.2017.01.024.
7) Ashtari, S. and Eydgahi, A. (2017) 'Student perceptions of cloud applications effectiveness in higher education', *Journal of Computational Science*. Elsevier B.V., 23, pp. 173–180. doi: 10.1016/j.jocs.2016.12.007.
8) Avram, M. G. (2014) 'Advantages and Challenges of Adopting Cloud Computing from an Enterprise Perspective', *Procedia Technology*. Elsevier B.V., 12, pp. 529–534. doi: 10.1016/j.protcy.2013.12.525.
9) Bouyer, A. and Arasteh, B. (2014) 'The Necessity of Using Cloud Computing in Educational System', *Procedia - Social and Behavioral Sciences*. Elsevier B.V., 143, pp. 581–585. doi: 10.1016/j.sbspro.2014.07.440.
10) Christopher, O., Temitayo, F. and Comfort, D. (2014) 'The Impact and Challenges of Cloud Computing Adoption on Public Universities in Southwestern Nigeria', *International Journal of Advanced Computer Science and Applications*, 5(8), pp. 13–19. doi: 10.14569/IJACSA.2014.050803.
11) Islam, T. and Manivannan, D. (2016) 'A Classification and Characterization of Security Threats in Cloud Computing A Classification and Characterization of Security Threats in Cloud Computing', (March).
12) Joshi, M. (2015) 'Emerging Trends of Cloud Computing in Education Methodologies : A Review', *International Journal of Advanced Research in Computer Science and Software Engineering*, 5(12), pp. 3–6.
13) Karim, F. and Rampersad, G. (2017) 'Cloud Computing in Education in Developing Countries', *Computer and Information Science*, 10(2), p. 87. doi: 10.5539/cis.v10n2p87.
14) Koch, F. *et al.* (2016) 'Optimising resource costs of cloud computing for education', *Future Generation Computer Systems*. Elsevier B.V., 55, pp. 473–479. doi: 10.1016/j.future.2015.03.013.
15) Mell, P. and Grance, T. (2011) 'The NIST Definition of Cloud Computing Recommendations of the National Institute of

Standards and Technology', *National Institute of Standards and Technology, Information Technology Laboratory*, 145, p. 7. doi: 10.1136/emj.2010.096966.

16) Mircea, M. and Andreescu, A. (2011) 'Using Cloud Computing in Higher Education: A Strategy to Improve Agility in the Current Financial Crisis', *Communications of the IBIMA*, 2011, pp. 1–15. doi: 10.5171/2011.875547.
17) Okai, S. *et al.* (2014) 'Cloud computing adoption model for universities to increase ICT proficiency', *SAGE Open*, 4(3), pp. 1–10. doi: 10.1177/2158244014546461.
18) Puthal, D. *et al.* (2015) 'Cloud computing features, issues, and challenges: A big picture', *Proceedings - 1st International Conference on Computational Intelligence and Networks, CINE 2015*, (Cine), pp. 116–123. doi: 10.1109/CINE.2015.31.
19) R, P. M. (2015) 'Survey on Security Concerns in Cloud Computing', pp. 1458–1462.
20) Rad, B. B. and Rana, M. E. (2017) 'Cloud Computing Adoption : A Short Review of Issues and Challenges'.
21) Rangavittala, S., Sanjay, H. A. and Salvi, S. (2015) 'Enhanced Multi-Tenant Architecture for DaaS, PaaS, IaaS and SaaS in Edu-Cloud: Simplifying the Service provisioning in Edu-Cloud by multi-tenant architecture', pp. 51–56. doi: 10.1145/2818567.2818577.
22) Shahzad, A. *et al.* (2016) 'Opportunity and Challenges using the Cloud Computing in the Case of Malaysian Higher Education Institutions', *The International Journal of Management Science and Information Technology (IJMSIT) Issue*, (20), pp. 1–18. Available at: http://eds.a.ebscohost.com.ezp.waldenulibrary.org.
23) Srinivasan, A., Abdul, Q. M. and Vijayakumar, V. (2015) 'Hybrid cloud for educational sector', *Procedia Computer Science*. Elsevier Masson SAS, 50, pp. 37–41. doi: 10.1016/j.procs.2015.04.008.
24) Taufiq-Hail, G. A., Ibrahim, H. and Yusof, S. A. M. (2017) 'SAAS cloud computing as a means of green IT acceptance model: A theory of planned behavior model at Malaysian public universities' context', *Journal of Information System and Technology Management (JISTM)*, 2(3), pp. 1–17.