Review & Proposal for a Cloud based Framework for Indian Higher Education

Sreevidya Subramanian[1], Dr.Ananthi Seshasaayee[2]

[1]Vels University, P.V.Vaithyalingam Salai,
Old Pallavaram, Chennai, India
sreevidya.research@gmail.com

[2]Associate Professor & Head, PG & Research department of Computer Science & Applications,
Quaid-e-millath College for women, Chennai, India
ananthi.research@gmail.com

Abstract: *we are moving towards a smart evolution a Social Learning era fostering hype towards cloud enhancement and an era of fast change. We are always on the lookout to find better ways to accomplish our ordeals. In spite of a harsh global economic situation, our ability to fashion new technologies, to harness the power of information appears healthier than ever. In this paper, we are going to focus more on reviewing the current pace of cloud invasion on higher education. This will also list out the best practice to be implemented in order to accomplish what we foresee as a smart era.*

Keywords: Virtualization, Grid, Resilience, IaaS, SaaS, PaaS.

1. Introduction

Imagine the time when people worked under candle light doing math calculations on paper, the old fashion way, before electricity came about in the early 20th century. Now, most of the civilized world wouldn't know what to do with themselves without technology. Imagine not even having a calculator for math or the internet to do research. We are currently in a Social Era of Learning (1) and now adapting this to Indian education. The most important benefit of leveraging cloud technology for the purpose of education is to resolve the hiccups in terms of:

• Cost - Pay as you go – cheap and beneficial according to your usage standards.

• Flexibility - Maximize the investment made through resilience and scalability.

• Privacy - Help make data and services publicly available without jeopardizing sensitive information. It is always a necessity for universities to think of security as an important avenue for migration to cloud.

Current trend is to use a hybrid deployment model (2) for hiding sensitive data from the public. A major requirement criterion when it comes to enabling education through the use of cloud technology is availability factor across 24x7x365 days. Google (3), Amazon (4), Microsoft (5) etc., are in to a tough competition to showcase their apps for education in cloud.

Security (6) is especially a pressing issue for migrating to cloud for higher education. With many faculty members pursuing their patent-pending research, and with student privacy safeguarded by strict regulations, colleges, schools and universities must be very careful to minimize exposure to legal risk and compliance risk. A secure and reliable networking infrastructure is therefore a flat out requirement. Decision to choose one depends on a number of factors:

1. Previous technology investments
2. Current licenses
3. Existing or New Partnership possibilities and
4. Comfort levels.

2. Prerequisites for Implementing Cloud based educational framework

Katz et al. (2009) identified 10 important features of cloud computing in higher education with respect to on-demand SaaS, PaaS, and IaaS (7):

- Increasing access to scarce IT expertise and talent.
- Scalability of IT Resources and Services.
- Promoting further IT standardization.
- Time to Market Adaptions.
- Counter Ad hoc consumerization of enterprise IT services.
- Transparency of Funding and On Demand supply.
- Increasing interoperability between disjoint technologies within and between institutions.
- Supporting a model of a 24 x 7 x 365 environment.
- Enabling the sourcing of cycles and storage powered by renewable energy.
- Driving down capital and total costs of IT in higher education.

2.1 Right-sized Infrastructure with proper internet capacity.

World is moving now towards BYOD methodology and most of the universities have adapted towards this process in other countries. Though there are possible pitfalls in allowing an external system to access and update confidential data inside our data center, there is also another important requirement for consumers today – Good Internet Bandwidth. Best Placed Infrastructure coupled with good internet connectivity is the key to the overall optimal use.

2.2 Being a Facilitator not a moderator

As technology grows so does the mentors, because they will have to eventually teach that technology down for the students. It is time for the faculty members to be a motivator for new inventions and a facilitator to help students focused on their studies and assignments. Most importantly the grading system of today's education must change. Every semester will now have to provide practical applications of what they have learnt in the form of projects which will be the only evaluation criteria for grading. This will help students to come up with innovative ideas and experiments.

2.3 Lacking Resources – Who must help?

Focal point of stronger and better economy is to engage young minds into various patented innovations in science. It becomes our responsibility to shape a child's future in the best way. We used to have a period of time when schools had limited materials to support extended learning and students were seeking libraries support for enhancing their education. Eventually this shifted pace in to digital libraries with the introduction of internet. Instead of just providing efficient internet connectivity and a laptop, one must feed the idea of self-exploration and creative thinking in the minds of young researchers for which faculty members play a vital role. We can also focus on establishing an open public cloud consortium for online digitized libraries purely for the purpose of self-learning and not for copyrighting which is purely a read only access. Such massive scale setup requires enough funding and skilled resources for maintenance and proper partnering facilities with organizations like books 24x7, skill port could be of added advantage.

2.4 Special Education Needs

It is immensely difficult to invest the thought of proper education in the minds of Children, especially for Special Children the level of concentration proportionally increases. With very less schools and universities having such facilities for Special education, it is also responsibility of the respective Governments to take action based on the statistics of Special Children existence in the respective areas.

A Special census for those children is warranted based on which there can be measures taken to improvise or increase schools/universities in the needed areas (8).

Many companies have come forward in providing alternative education platforms through the help of cloud. Students are no longer required to come to schools/universities / special education centers to use those applications. They can work from home or elsewhere. This is a boon for students with limited mobility.

United Nations Information Centre (UNIC) for India and Bhutan were the first ones to organize a conference to stimulate new thinking on innovative users of cloud technology (9) They also discussed and debated the role and relevance of cloud computing in libraries. This conference proved useful to come up with an action plan for migrating libraries into cloud environment. But this has been struck just as an idea and not a reality.

Cybrarian (10) is a product from CR2 Technologies based out of India. It is Asia's First SaaS based Integrated Library Automation Solution allows Librarians to manage their library online. All resources based on security are well indexed in reputed search engine like Google, yahoo, live and more. State Government should establish tie ups with subsidized membership options to students to provide a library on the move solution.

3 Review of Cloud Adoption in India – Success Stories

3.1 Accomplishments

It is an acknowledged fact that Cloud can serve as a viable source for enhancing and running far better and different towards achieving goals for students but the implementation cost and associated constraints on bandwidth still remains a blocking point for us.

This has potentially resulted in hesitation amongst government and delay in adapting to the Cloud models. There must be a comprehensive policy and strategy for "Cloud Adoption in India", ubiquitous approach should be adopted by building a composite platform with core components such as base infrastructure, key software components can be ERP, ECM, Office 365 for mailing and documentation purposes, File Sharing servers, Central Versioning repositories for programmers & BPM Platforms.

The key non software components for setting up a cloud infrastructure are following:

Connectivity & Bandwidth- This involves connectivity between the application hosted on cloud infrastructure as well as the connectivity between the end customer and hosted applications. The connectivity is poor at remote location as well as the penetration of Internet is low.

Land & Real Estate- To set-up a large data center you need multiple acres of land which is also a challenge as prices of properties in India is going up very fast.

Security – The security is also a concern area for cloud infrastructure. Need to devise a hybrid cloud model to encapsulate confidential data of universities from potential hackers.

In order to reap the full benefits from Cloud adoption the Government needs to provide right infrastructure & policies in place so that challenges can be overcome. There were few universities adopting to cloud infrastructure. The prominent ones are explained further:

GITAM university, Vizag, India decided to implement a state-of-the-art network infrastructure, (11) for provision of applications developed as SaaS to other affiliated colleges and

universities. Some organizations implement cloud solutions with their existing bandwidth, and without extra hardware.

Bangalore-based Aurus Network's CourseHub is one such low-bandwidth video capture, management and distribution platform targeted at educational institutes. Others, such as Gate Forum, use the cloud to help final-year engineering students in small cities like Agra to prepare for the annual Graduate Aptitude Test in Engineering.

The largest on-ground implementation (12) is **NIIT's Cloud Campus**, now available in over 150 centers nationwide. Top notch features of this platform are given below:

Cloud based Classrooms – Faculty connects to students across locations (geographies) and relevant courseware and lab exercises are available online 24x7.

Blended Classrooms – Apart from getting taught by a Faculty (Expert in that domain), additional tutorials and help in the form of e-learning videos are available for the students to deep dive in to their respective subjects.

Flip Classrooms – This is helpful when connectivity is an issue and to help with students, there is a provision of download of course materials and e-learning materials for their use offline.

The adoption of the cloud in schools is expected to pick up once issues around connectivity are resolved. This could happen after the high-speed Network starts reaching the villages that most require such assisted education. Several companies like cisco, Google, Microsoft etc., have come forward to help us with the necessary infrastructure in India.

Another successful adoption is called **"Dwarka",** the code name for Cisco Education enabled development (CEED) which is a completely cloud based remote solution for higher education and is promoted by Government of Karnataka government(13). It is currently being implemented in a handful of rural schools, and to train teachers in some districts. Private schools and technical education institutions are also adapting this technology. Prominent Features of this solution are given below:

- Fully equipment Classrooms with necessary infrastructure setup inside each classroom (e.g. router, projector, speakers, cameras etc,)

- The overall cost per child is just $1 as the manufacturing and procurement is happening from within India.

- Completely theft and Heat resistant environment.

- Piloted in various locations in Karnataka with total utilization of 600,000 hours.

- Ability to interact with students across various locations on a virtual classroom basis.

All India Council for Technical Education (AICTE) has partnered with Microsoft Corporation India Pvt.Ltd. to implement Cloud email offering for all its institutes. In order to get your institute on-board free of charge, Microsoft Partners – Malhaar iMarketing Advantage(IMA) will get in touch with the

interested educational institutions. As a part of Cloud Adoption all institutes get access to Microsoft Office 365 for Education. The planned milestone for completion was marked for 30th June 2013 and it is in progress (14).

4 EDUCLOUD - Proposed Cloud based educational framework for Indian Universities

When it comes to migrating to cloud, it is always the big and high risk decision (15). Hence, the following factors are to be carefully analyzed:

Know your security and compliance needs- Can the provider meet them? Transparency, compliance controls, certifications, and auditability are some of the key criteria to evaluate.

Compare vendor offerings—it is not just for features and costs but also for uptime, security, and flexibility.

Ask whether service levels are negotiable - And what happens if the vendor falls short—are there meaningful penalties?

4.1 Software as a Service Options for Education

1. E-mail, calendar, and instant messaging

2. Desktop productivity, such as document creation and sharing

3. Collaboration and presence

4. Payment processing

5. Identity and relationship management

4.2 Platform as a Service Options for Education

1. Coordinating collaborative software development projects that involve multiple departments

2. Developing applications that can be shared by many users simultaneously

3. Creating social networks or communities according to grade, school, or area of study

4. Porting on-premise, line-of-business applications to the cloud

5. Deploying Web services quickly

6. Creating mash-ups of data to meet accountability and assessment needs

4.3 Infrastructure as a Service Options for Education

1. Hosting community and other public-facing Web sites.

2. Storing—especially public data. The public cloud might even be a safer place to store data than your own data center.

3. Testing large-scale applications in a discrete environment before deploying publicly.

The below cloud deployment model (EduCloud) is advised for Higher education. It is a combination of Private Cloud & Public Cloud (commonly termed as Hybrid Cloud). The reason to opt for a hybrid cloud is to ensure that adequate security is

maintained when it comes to sensitive information on the cloud. The grades of student's thesis and research work along with their details and faculties personal details are to be stored on to a private cloud whereas the applications and assessment details can be stored on to a public cloud.
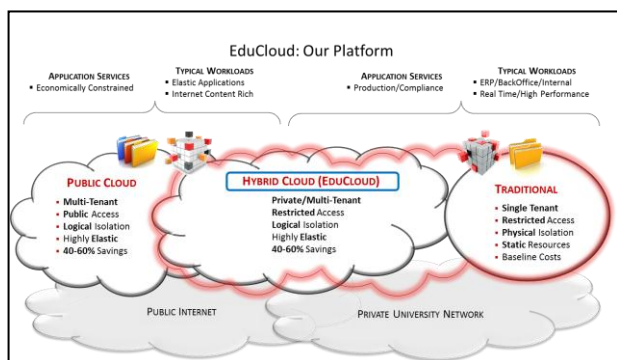

Fig.1. EduCloud – Platform Overview

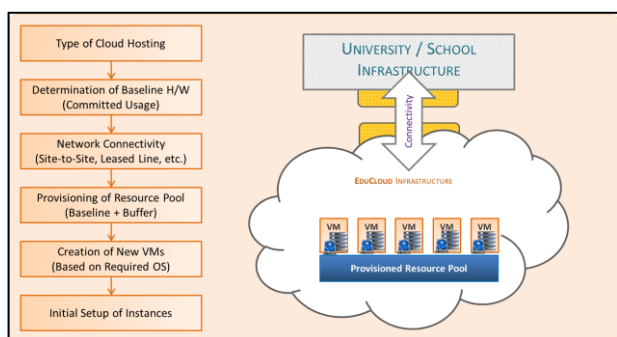The decision made should be ideally following the below principle:

Fig.2. EduCloud – Workflow Approach

This Framework explains that the provisioning of Applications as well as storage and virtual machines are instant and will be scalable as per the requirements from the universities or schools and most importantly will be on pay as you go service model.

1. Workflow of a typical student, A notification service (preferably by email) will notify the students about their new assignments and exercise to be completed within the prescribed due dates along with the relevant tutorials and videos for virtual classrooms. This will ideally by uploaded to the cloud server by the respective faculties.
2. Following this notification, the student must acknowledge the acceptance of the notification by checking out the required files and start working towards completion of their assignments. This may involve performing an interim research assignment or undergoing tutorial / VC sessions and will check in back the completed exercises.For this process, the student will utilize the 24x7x365 virtual lab setup for this purpose.
3. The Students and the respective faculties will then from time to time access the database for updating their educational activities for the fulfilment of the semesters.
4. The administrator on the otherhand will take care that the authentication of students and faculties to access virtual labs and databases are following the strict

guidelines and will audit the logged files and take necessary actions. He/she will also be responsible for taking regular backup of important files and also taking care of maintenance of these virtual machines.

The proposed framework is just the road map for the implementation of a whole virtual cloud based teaching-learning and service delivery ecosystem. After the system is ready to use an independent study comparing the teaching-learning process and service delivery using the proposed framework with the original teaching-learning process and service delivery environment should be conducted. This framework can be tested in departmental level before fully implemented for all universities or at schools.
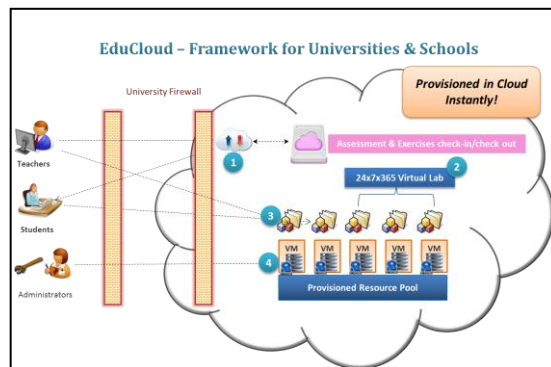

Fig.2. EduCloud – How does it work?

The research possibilities regarding Cloud Computing for educational purposes are immense since the technology is relatively new. Research in the education fields has much to be examined, but there is not yet a clear definition and standard for such technology. The movement will be rapid after the standardization.

5 Risks & Challenges associated with Cloud Adoption

Before using any cloud provider or service give the following factors due consideration (16):

Non-negotiated terms of use – Most case, one may have to only accept the provider's terms of use and there is no possibility of negotiation. This ideally means that we must read the terms of use before accepting to it.

Control of User Content - Terms of use may include a provision that, by using the service, the user is granting the service provider a broad range of rights to use the content the user places in the service stating that if the content is declared objectionable. Users should take care to note the difference between ownership and rights of use. By accepting to such terms we are voluntarily jeopardizing the confidential data usage. Hence it is advisable to have these sections called out separately in the agreement.

Security and privacy - What level of security is provided for the customer content? Have they got certified access policies and protocols outlined? The level of data detainment is also a point to discuss. Leakage of Confidential information is another key factor.

Backups - Do the terms of use commit the service provider to back up user data? This could be one of the reasons why the user data can also be altered by the service provider.

Assured purging - Do the terms of use commit the service provider to fully delete from the service any content, including distributed or backup copies, that the user has intentionally deleted from their use of the service?

Non-negotiated changes to terms of use - Are the terms of use posted obviously on the service's website, or are they hard to find? What do the terms of use say about the service provider's ability to change the terms of use? Do the terms of use commit the service provider to: notifying the user of any such changes? or simply posting changes on the service's website, with the user being responsible for constantly monitoring the posted terms of use to know when they have changed? Do the terms of use require that the user formally acknowledge changes to the terms of use, or does the user accept the new terms simply by continuing to use the service? It is not unusual for terms of use to grant the service provider the right to change the terms of use at any time and in any way without the permission of the user and frequently without notifying the user. This simple provision means that the "agreement" essentially provides no real protections for the user, because any of the protections articulated in the version to which the user agrees can be changed at any time by the vendor. (Note: In early 2008, some terms of use for cloud services were observed to change as frequently as every 2 months.)

Non-negotiated changes to the service - Can the service provider change the service itself (for example, stop providing it at all) without notice to the user? If with notice to the user, what period of advance notice is provided to the user by the service provider, and by what means (direct notification; a posting on the service website)? Remember that a service may terminate due to the service provider's business failure or acquisition by another party, and that this may cause abrupt changes not addressed by the terms of use.

Non-negotiated changes to the business model - Can the service provider change its business model? How likely is it to change its business model? Critical changes to the business model could include changes to the service feature set, or changes to the pricing model, or a combination (e.g., moving from "all features free" to "basic features free; valuable features at a price").

Data formats - Do the formats in which data are stored by the service follow commonly-used standards or are they proprietary and unique to the service provider? Will the user be able to easily remove their content or copies of the content, from the service and use it in other places or with other applications?

Indemnity - Just how vital to University business is the use being made of the service? What if something truly unwanted happened while University data were deployed in the service (e.g., a major business disruption)? Terms of use generally contain language by which the user agrees to hold the service provider harmless if the service provider does any damage to the user's data or ability to use the service (to support the user's business uses). Sometimes the indemnity language is even more favorable to the service provider, and may expose the user to liability to pay the service provider's legal expenses.

Innovative institutions of higher education must seek to understand why and how to deploy cloud platforms efficiently and securely. Ultimately the choice should depend on available opportunities, approaches and partners. It is said that in the next five years, institutions of higher education expect to cut 20% of their IT budget by moving applications to the cloud [17].

6 Conclusion & Future Work

Some of the cloud computing requirements are the same across any organization. However, Schools/colleges/ Universities tend to face issues particularly on the following areas:

Robust Security and Privacy is critical – Security and data privacy implications are the foremost concern for many higher education organizations. With the introduction to BYOD, the complexity increased trifold.

Strike the right balance between private and public cloud – Universities must determine the right balance between public and private cloud or hybrid cloud, taking all relevant legal and security issues into consideration, and pursue a change management strategy so that students also can understand why the university favors some special applications.

Any strategy should firmly position education as the top most priority – in the higher education space, goal is to only give IT the opportunity to support the primary focus and function which is educating students.

From this review we understand that the following are the potential benefits of introducing Cloud for education:

- **Flexible services** - Drive innovation with data services in the cloud that students, teachers, faculty, and staff can reuse.

- **Infrastructure** - Get all the IT resources you need, only when you need them, managed securely and predictably. And pay for only what you use. Any budget-constrained institution has to like that.

- **Applications and content** - Rather than waiting in the software procurement line, get hosted software, datasets, and services so fast you'll have plenty of time to work on your mission.

- **Policies and regulations** - Proceed carefully, but note how cloud computing can help you meet your institution's compliance requirements.

- **Creative IT** - Free your IT department from a keep-the-lights-on approach to foster some creative problem solving that can help teachers better engage their students.

Future Work

The proposed model is an outcome of analysis and comparison done on existing implementations. After successful set up of virtual cloud infrastructure a frequent performance and usage analysis needs to be done in order to test and enhance the efficiency of the framework.
Efficiency can be tested on the following parameters:
1) Effective utilization of cloud accounts.
2) Performance and Stability of the IT Systems.
3) Resilience and scalability of existing infrastructure.

References

[1] Concept of Social Learning - http://www.theguardian.com/teacher-network/teacher-blog/2013/jun/19/technology-future-education-cloud-social-learning

[2] NIST Reference Architecture - Beizer, Doug. "NIST creates cloud-computing team." Federal Computer Week, February 25, 2009. http://www.fcw.com/Articles/2009/02/25/NIST-cloud-computing.aspx

[3] Google Apps for Education - http://www.google.com/enterprise/apps/education/

[4] Amazon for Education - http://aws.amazon.com/education/

[5] Microsft Live@edu - http://www.microsoft.com/education/en-us/solutions/Pages/liveedu.aspx

[6] Issues and Risks on migration to cloud - http://www.universitybusiness.com/article/cloud-computings-top-issues-higher-education

[7] Katz, R. N., Goldstein, P. J. & Yanosky, R. (2009). Demystifying cloud computing for higher education, EDUCAUSE Center for Applied Research Bulletin, 19, 1-13.

[8] Cloud supporting Special needs education - http://thoughtsoncloud.com/index.php/2012/11/special-needs-education-how-cloud-computing-is-making-a-difference/

[9] Cloud Computing: Moving Libraries to the web - http://www.unic.org.in/displaymore.php?chname=Events&subchkey=&itemid=12664&subid=

[10] http://blog.cr2.in/2011/12/10/library-automation-in-the-cloud-cybrarian-httpwww-cybrarian-in-is-easy-to-use-and-easy-on-the-budget/

[11] http://www.informationweek.in/education/13-08-08/gitam_strives_to_become_digital_university_with_single_ip_network.aspx

[12] NIIT Cloud Campus Offerings - http://www.indianexpress.com/news/niit-launches-cloud-campus-targeting-students-professionals/1112612/

[13] Cisco CEED (Dwarka) Initiative for Higher Education in India - http://www.informationweek.in/education/13-03-06/cisco_launches_cloud-based_remote_education_platform_for_indian_classrooms.aspx.

[14] AICTE Partnership with Microsoft for Education in India - http://www.thehindu.com/todays-paper/tp-features/tp-opportunities/microsoft-office-365-for-education-deployment-at-aicte/article4189947.ece

[15] Top 10 known issues on cloud - http://www.universitybusiness.com/article/cloud-computings-top-issues-higher-education

[16] Catteddu, D., & Massonet, T. (2010). Cloud computing: Benefits, risks, and recommendations for information security. Retrieved from http://www.trust-itservices.com/download/Cloudscape-II/Channel_presentations/Tuesday_11.00-13.00/Philippe_Massonet-Cloud_Computing_Benefits,risks_and_recommendations_for_information_security.pdf

[17] CDW-G. (2011). From tactic to strategy: The CDW 2011 cloud computing tracking poll. Retrieved from http://webobjects.cdw.com/webobjects/media/pdf/Newsroom/CDW-Cloud-Tracking-Poll-Report-0511.pdf

Author Profile

Sreevidya Subramanian is a Research scholar at Vels University pursuing her Ph.D Degree on Computer Applications. She is also working as a Migration Architect for SAP ERP Solutions at Cognizant Technology Solutions, Chennai. She has published several papers on cloud security and has also participated in several conferences. She is also actively involved in Gartner Research Circle and CSA Working groups

Dr. Ananthi Sheshasaayee MCA., M.Phil (C.Sc.), Ph.D., PGDET., with 22 years of academic experience, currently heading the PG & Research department of computer science & applications at Quaid-e-millath Govt. College for Women (Autonomous), Chennai 2, TamilNadu. Successfully guided 5 research scholars with their Ph.D.s and 23 with M.Phil (C.Sc). and also guiding at present .On the verge of completion of a Minor research project sanctioned by the UGC-SERO, on data structures and their applications.Recipient of Dr. Radhakrishnan gold medal for Potential excellence under "Individual achievements & National Developments".