# Adaptive User Interface for E-learning Applications based on Learning Styles using Web Logs Analysis: A Hybrid Cloud Architecture

Sucheta Kolekar, Radhika M. Pai, Manohara Pai M. M.
Department of Information and Communication Technology
Manipal Institute of Technology, Manipal University
Karnataka, India
{sucheta.kolekar, radhika.pai, mmm.pai,}@manipal.edu

***Abstract*—Emerging Cloud Computing technologies are changing the way of deploying and accessing web applications. E-learning web application is not excluded from the effect of Cloud. Different e-learning deployment models have been proposed and implemented by researchers. In order to combine both emerging trends, one should understand the requirement of educational institutes for online courses and infrastructure. Institutes should not only focus on providing the various online courses to learners but also emphasize on getting the learner's requirements from the e-learning applications as per their learning styles. With the help of cloud deployment model, institutes can increase the participation of learners for taking online courses. In this paper, the conceptual architecture is proposed which focuses on adaptive e-learning application to provide adaptive interface based on learner's learning styles and deploys the application on hybrid cloud to achieve various non-functional requirements. The paper also discusses about two new e-learning services on cloud such as Learning Styles as a Service and Adaptive Interface as a Service.**

***Index Terms*—Cloud Computing, Hybrid Cloud, Adaptive E-learning, Adaptive Interface as a Service, Learning Style as a Service, Felder-Silverman Learning Style Model.**

## I. Introduction

Education plays a vital role in developing countries in order to maintain economic growth. In India, the biggest challenge is to provide quality education with high end infrastructure as the population is increasing rapidly. India is moving towards knowledge based economy than traditional resource based economy. To achieve knowledge based economy, education should be available anywhere and anytime. The traditional class room alone is not sufficient to provide quality education to mass population. At the same time tremendous development of Information and Communication Technology (ICT) has changed the complete picture of education. The ICT is getting accepted very rapidly by Indian young population in order to acquire quality education. Today, E-learning applications are widely being used by mass learners as an additional way of learning along with the Classroom learning.

With increasing numbers of learners, wide range of learning services and the growth of educational content, e-Learning has become more popular mode of learning and has great future. However, due to the tremendous growth in scalability, massive storage and transfer of rich multimedia course contents, e-learning applications require high configuration server system to provide E-Learning services. Generally, E-Learning applications are web based and follows client-server architecture for the deployment. But this architecture has some limitations such as lack of scalability, elasticity and security. Since the E-Learning applications are not getting delivered with high end network, the learning services cannot be shared and delivered efficiently to the learners [1].

Many institutions do not have the resources and infrastructure needed to run the E-Learning solutions and want to go for open source environments such as Moodle where basic E-Learning services can be generated [2] [3]. Cloud Computing offers a dynamic provision of virtualization for different resources, on demand elasticity, scalability and metered service. Educational institutes can reduce the cost of infrastructure, software and human resources by adopting cloud computing to deliver E-Learning services.

Cloud computing has many benefits for E-Learning application by providing the virtualization of infrastructure, data storage, platform and educational services. With these benefits most of the E-Learning systems focus on delivering multimedia contents to the learners for different courses. E-Learning systems provide the same resources to all learners even though different learners need different information according to their level of knowledge, ways of learning style and preferences [4]. Now a days traditional E-Learning systems are replaced with adaptive E-Learning systems which focus on understanding learners and generate contents as per learning styles.

This paper presents a proposed architecture for adaptive E-Learning portal on hybrid cloud which reduces the infrastructure costs and maintains security. It understands the learning preferences of individual learner and provides the user interface according to pedagogical aspects. End users have unique ways of learning which may directly or indirectly affect the learning process and its outcome. In order to implement effective and efficient E-Learning, the application should be capable of not only adapting the content of course to the

978-1-4799-8641-5/15/$31.00 

individual capabilities of students but also concentrate on the adaptive user interface according to student's requirements. Since E-Learning is web-based educational system, it is capable of collecting vast amounts of learner profile data and can be analyzed using data mining and knowledge discovery techniques to find interesting relationships between attributes of learners and the solution strategies adopted by learners. Section II discusses the related work in cloud computing and e-learning area. The section III discusses about the basics of cloud computing and e-learning. This section also discusses about the factors which need to be considered while implementing e-learning on cloud computing. The proposed approach is discussed in section IV; Section V gives an information about implementation of proposed approaches, followed by conclusion in section VI.

## II. Related Works

B. Dong *et al.* [1] developed an E-Learning framework based on cloud computing, namely BlueSky. This cloud framework has six layers: user interface, application, common service, capability, data information, virtual infrastructure.

P.H. Liang and J.M. Yang [2] described Virtual Personalized Learning Environment (VPLE) to integrate multiple application systems of schools into one integrated online system. The learning content providers can dynamically register new applications and students can personalize the contents of their learning environments.

F. Doelitzscher *et al.* [3] have introduced CloudIA which is a comprehensive private cloud solution to provide IaaS, SaaS, PaaS with respect to requirements and needs of E-Learning and collaborative learning. The ClaudIA IaaS system creates a VM by choosing OS image and software packages selected by the user from the internet. PaaS approach allows students to use VMs for their courses. Collaboration Software (CollabSoft) has been adapted to a SaaS model.

P. Paul *et al.* [5] presented the positive impact of using cloud computing architectures upon E-Learning solutions development. It focuses on the benefits of cloud computing for E-Learning solutions and the E-Learning project management challenges when this architecture is used.

B. Dong *et al.* [6] has given a good theoretical and practical basis about using CC infrastructure in E-Learning. Authors have presented an E-Learning ecosystem based on Cloud computing infrastructure. Cloud computing infrastructure and related mechanisms allow for the stability, equilibrium, efficient resource use, and sustainability of an E-Learning ecosystem. The authors have mentioned the importance of cloud services into an E-Learning system.

N. Sultan [7] has mentioned that some universities have implemented cloud based E-Learning services using public cloud providers such as: Google, Microsoft, Amazon, etc. For example, the University of Westminster used the Google Apps for Education platform that provides a set of Google services (e-mail, document management and collaboration tools) for the the teaching and learning process.

D. R. Herrick [8] has discussed that Colorado State University used Google Apps for Education. But there are no tools and interfaces for teachers to supervise students and no adaptive learning services.

S. Rajam *et al.* [9] have proposed E-Learning computational cloud (eLC2) that enables E-Learning task management. Main goal of the eLC2 solution is to build the collaboration among the learners-instructors for learning activities.

M. Desptovic-Zrakic *et al.* [10] proposed a method for the integration of information, processes, applications and human resources in the E-Learning system. Integration is based on a web application developed for managing the learning environment. The application enables integration of the Moodle, the OpenLDAP and the OpenNebula open source cloud computing infrastructure. Since Moodle uses static nature of creating web applications, adaptive interface incorporation is difficult.

T. Kaewkiriya and N. Utakrit [11] focused on the particular technologies that have been applied to support education, for instance, learning management systems and E-Learning. Authors have presented a conceptual model of distributed learning management systems by using Cloud computing combined with web service technology.

D. K. Viswanath *et al.* [12] proposed cloud computing to E-Learning from the following aspects: its work mode, services, business model, benefits & issues.

M. Al-Zoube [13] has presented a cloud computing based solution for building a virtual and personal learning environment. The proposed environment is used for designing and monitoring of educational content as well as creating a platform for exploring ideas. The system allows exchange of educational content and integrate different pedagogical approaches to learning and teaching under the same environment. The system focuses on contents but not on user interface and learning styles of learners.

M. Phankokkruad [14] has proposed the cloud computing architecture in the E-Learning which includes infrastructure, platform and application. This architecture is required to design components in order to transfer the learning resources on the cloud platform.

Md. Masud and X. Huang, [15] have presented a framework that specifies processes for academic institutes as well as organizations to adopt cloud computing. Authors have not considered usability aspect which is mentioned in future scope.

S.M. Chuang *et al.* [16] have provided a cost effective structure of hybrid cloud architecture that has implemented the multi-tenant model for enterprise to support customization sharing among different virtualized applications. The architecture is based on Windows Azure Platform for system scalability. The total cost of the hybrid cloud based enterprise E-Learning platform can save upto 30%.

## III. Cloud Computing in E-Learning

The NIST (National Institute of Standards and Technology) definition of Cloud Computing states that cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., servers, storage, networks, applications and

services) that can be rapidly provisioned and released with minimal management effort or service provider interaction [4].

### A. Cloud Computing Architecture

Cloud architecture consists of multiple resources working with each other with loose coupling between them so that the application will not have direct dependencies and resources can be managed by adding, updating or changing in case of requirement/failure without affecting the rest of the system. It involves both hardware and software resources. Fig.1. shows multiple resources and services together provisioned to specific applications.

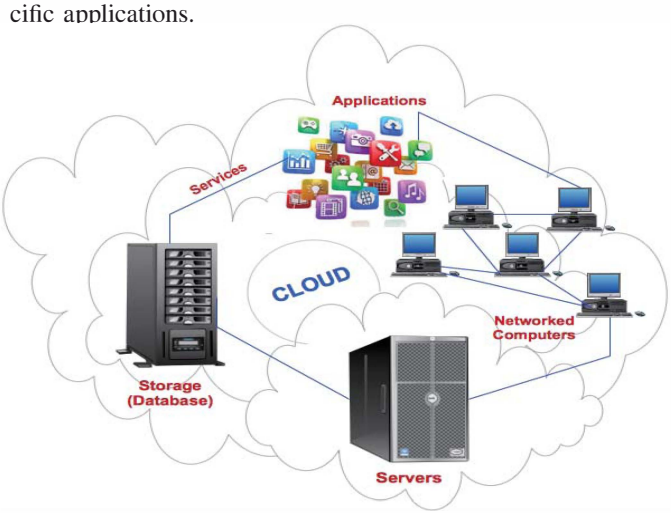


Fig. 1. Basic Architecture of Cloud Computing

### B. Cloud Computing Model

Fig.2. depicts NIST Model of Cloud Computing. It supports four deployment models: Public Cloud, Private Cloud, Hybrid Cloud and Community Cloud. Public cloud such as Google, Amazon, and Microsoft provide cloud services, such as storage systems and network.

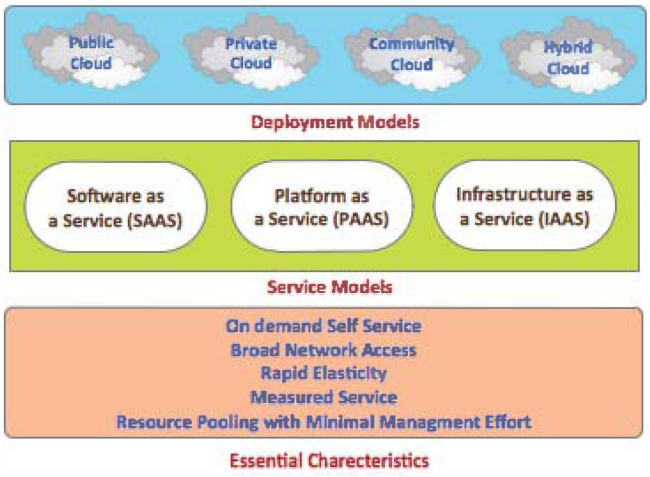


Fig. 2. NIST Model of Cloud Computing

Private cloud is built by one client and it provides data security and quality of service. The organization has its own infrastructure and deploys it on a data center. Hybrid cloud combines both public and private cloud models. It provides on-demand externally provisioned hardware and networking facilities. Community cloud is accessible to common purpose communities where, one organization owns private cloud and can give access to community organizations [17].
Cloud computing describes three service models: Software as a Service (SaaS) is a software distribution model in which applications are hosted by a vendor or service provider and made available to customers over a network, typically the Internet. Platform as a Service (PaaS) is a paradigm for delivering operating systems and required software over the Internet without downloads or installation to create execution environment. Infrastructure as a Service (IaaS) involves renting the hardware resources used to support operations, including storage, hardware, servers and networking components.

### C. Non-Functional Requirements for E-Learning Application on Cloud Computing

E-Learning is a web based application which can be implemented using cloud computing and web 2.0 to provide different services by implementing Service Oriented Architecture (SOA). Web 2.0 supports content publishing over the Internet and allows people to create, publish, exchange, share and cooperate with new way of communication and collaboration (e.g discussion forums, shared toolkits). Applying Web 2.0 technologies to E-Learning can enhance interactive communication and collaboration among participants and learners who either possess related learning resources, or can help to discover and obtain the resources, or are willing to exchange and share the resources with others in the Web-based learning. In Web 2.0, learners can read and write to the Web, in which learners become the consumers and producers of learning resources. Thus, Web 2.0 provides a learning environment which has the potential to fundamentally change the nature of learning and teaching, through the creation of learner controlled learning web. Despite the benefits that cloud computing offers, there are several non-functional requirements that should be considered during the adaptation of cloud deployment model and services in E-Learning which are shown in Fig. 3.

- Availability: E-Learning application is internet based and it should be available anywhere and anytime with high bandwidth. Portal should be available for access not only in the campus but outside of the campus. It should guarantee a permanent service (24x7) with the use of redundant systems to avoid net traffic overflow. These requirements can be satisfied by deploying application on Public Cloud.
- Scalability: Currently, E-Learning systems are still weak on scalability at the infrastructure level. On public cloud, several resources can be deployed and assigned just for specific duration when receiving usage of portal is very high. The system need to add/delete new resources as and

when required. For example, scalability with respect to access will increase during exam time and it will be idle after exam. So by allocating resources dynamically, portal can manage scalability as per usage basis and reduces infrastructure cost.

- Security: Part of E-Learning database may be confidential and as the data is distributed on different servers on public cloud, data is out of the control for the customer. So there is a necessity to incorporate strong security measures as a service from cloud service provider with additional cost or data can be stored on the private cloud.
- Authentication: Accessibility of application must be based on strong authentication scheme. Since portal will be deployed on Public Cloud, cloud service provider can provide multi-factor authentication scheme to authorize valid learners.
- Privacy: Apart from strong security available on Public cloud, sometimes some data is private for that organization and learners of the organization. In this scenario, usage of portal and learning styles of learners are private information which can be stored on private cloud of the organization.
- Learnability: E-Learning application should concentrate on learners and not on contents. Portal should identify learning styles of learners and help learners and teachers identify correct material.
- Usability: Interface of E-Learning portal should be user friendly and should support adaptiveness and personalization. Based on learner's preferences user interface should change and generate recommendations for learners to understand learning material.

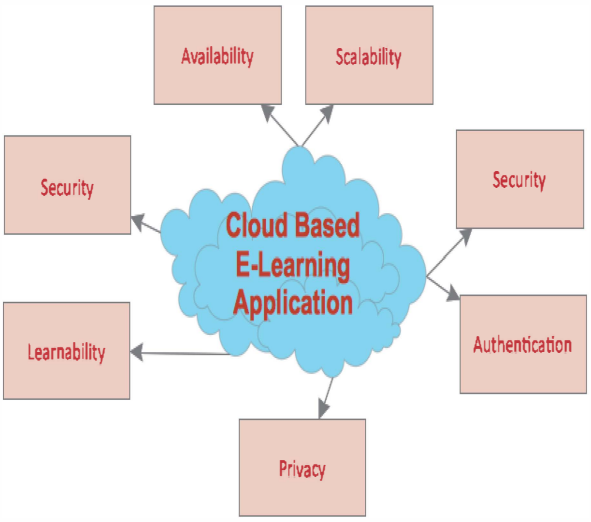


Fig. 3. Non-functional Requirements of E-Learning Application

In order to consider above mentioned non-functional requirements, E-Learning application should be adaptive and need to be deployed on hybrid cloud model. Hybrid cloud based application can provide required resources along with control mechanism to handle secured data. The internal analysis can be done at organization level and can be reflected online on portal.

### *D. Felder-Silverman Learning Style Model(FSLSM)*

The model adopted is the one suggested by Felder and Silverman (1988) for engineering education, which classifies learners according to their position in several scales that evaluate how they perceive and process information [18]. FSLSM combines several major learning style models. It is strongly influenced by other learning style models such as the learning style model by Kolb (1984), Pask (1976b) as well as the Myers-Briggs Type Indicator (Briggs Myers, 1962). Although the learning styles are not new but combinations of learning styles are new. Each dimension enables a detailed description of the learner's learning styles. This learning style model can be useful to identify strong learning style preferences as well as a weak learning style preference. The differentiation between strong and weak preferences is especially important when dealing with more than one dimension. In this case, the dimensions can have overlapping or contrary implications for providing adaptivity. Therefore, differentiation is essential in order to focus on providing courses that support the strong learning style preferences. The FSLSM has four dimensions (Pre-processing, Perception, Input and Understanding) and eight categories of learners (Active, Reflective, Sensing, Intuitive, Visual, Verbal, Sequential and Global) are shown in Fig.2.

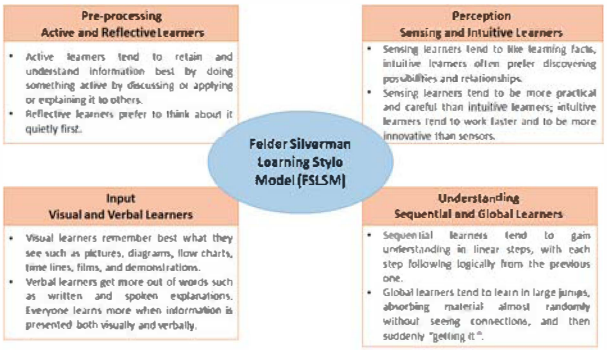


Fig. 4. Dimensions and Categories of FSLSM

## IV. Proposed Hybrid Cloud Approach

Effective Adaptive E-Learning has different adaptation approaches which mainly focus on content delivery and adaptive user interface on E-Learning portal. Main input factor to adaptation approach is learner's learning preferences which should be captured according to standard learning style model. Several learning style models have been proposed by Myers-Briggs, Kolb and Felder-Silverman out of which Felder-Silverman Learning Style Model (FSLSM) focuses specifically

on aspects of the learning styles of engineering students. Learning styles represent a combination of cognitive, effective and psychological characteristics that indicate the learner's way of processing, grasping, understanding and perception capabilities towards the course contents [19].

The adaptive E-Learning system is divided into two important modules. First part is portal and repository contents along with database of learners. Based on learning styles and type of learning profiles user interface components should get generated and reflected on portal. Second part is learner's usage data analysis which is used to identify the learning styles of learners and common learning profile. The usage data of any learner is private and analysis of that data reflects learner's level for specific academic organization [20].

Hybrid cloud based Adaptive E-Learning system uses Public Cloud and Private Cloud for deploying the above mentioned modules respectively which is shown in Fig. 4. First module provides E-Learning portal available online as Software as a Service (SaaS) on Public Cloud and second module provides Usage Data Analysis which is on Private Cloud.

The portal is deployed on the public cloud as a SaaS where required platform and infrastructure will be taken care by cloud service provider. The E-Learning contents repository will be deployed on public cloud storage where the capacity and bandwidth of accessing the contents will be managed by the cloud service provider. Learner's login credentials will be stored in the database with security, provided by public cloud provider. The online courses of portal along with course contents should be accessible to learners from anywhere and anytime.

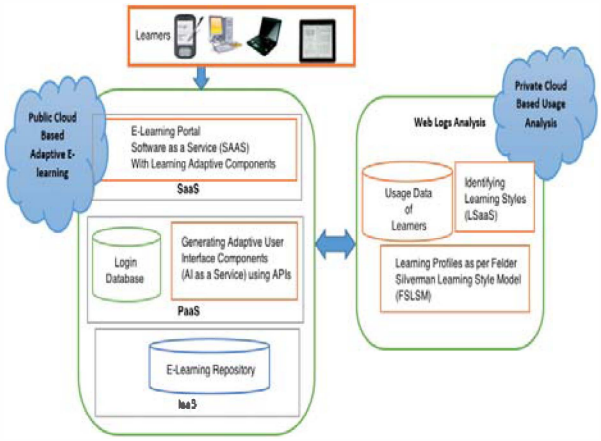


Fig. 5. Hybrid Cloud based Adaptive E-Learning

The public cloud will be connected with private cloud and web log usage data of portal for every learner will be pushed on to the private cloud. The private cloud infrastructure of the organization will be supported by the Data Centre where the Virtual Machine will be created for capturing of usage data into database. The usage data will be further analyzed to identify learning styles of learners based on Felder-Silverman Learning Style Model (FSLSM) and classified into eight types of learners (described in previous section). The profiles of learners can be push back to the public cloud. This can be offered as a Learning Style as a service(LaaS) on public cloud. On the private cloud web log usage data will be analyzed and learning styles of learners will be identified which can be available to be seen by the learners of that specific organization. This type of service will be called as Learning Styles as a Service (LSaaS) for learners. The LSaaS is an important factor for learners as well as instructors to modify the teaching learning process. The learner can understand his/her own learning styles and can access that specific learning components on the portal which will be provided by adaptive interface components manager. Instructors can also analyze the learning styles of learners to generate different contents which will be used to create adaptive interface.

The learning profiles of learners will be important input to generate user interface components which will be adaptively provided to individual learner on the portal. Based on eight learning classes, the components will be generated and stored on public cloud. The interface components should automatically change the existing structure of portal for that specific learner and will be used to create personalized learning environment.

On the public cloud, based on the learning styles and learning profiles adaptive interface components will be generated and automatically reflected into portal. This service can be declared as Adaptive Interface as a Service (AIaaS).

## V. Implementation Details and Benefits

In order to implement Hybrid Cloud infrastructure for application, Microsoft Azure public cloud can be used to deploy the web portal. Microsoft azure supports visual studio i.e. Dot Net for Web Application and Microsoft SQL Server for Database. Dot Net supports wide variety of web 2.0 feature to implement web application along with web services. Microsoft SQL Server Database can be connected with the database on machine which can be configured on Private Cloud/Open Source Private Cloud.

There are two approaches to implement private cloud:

- **With Proprietary Private Cloud**
  In our organization, IBM based private cloud infrastructure has been setup where the physical server is configured with Windows 2012 server. Microsoft hyper V is installed as a hypervisor to create Virtual Server for E-Learning Application. Microsoft visual studio and Microsoft SQL Server can be installed on Virtual Server in order to run the application which will analyze the Web Logs captured in SQL server database.
- **With Open Source Private Cloud**
  Open Source private cloud platforms can be installed on high configuration physical sever such as Eucalyptus, OpenStack or CloudStack to create virtualization environment. On this platform virtual server can be created with image of windows 2012 operating system. Once Windows server is ready, Microsoft visual studio and Microsoft SQL Server can be installed on Virtual Server in order

to run the application which will analyze the Web Logs captured in SQL server database.

The portal running on Public Cloud can have facility to capture web logs i.e. usage data of learners and can be pushed into database format on Virtual Server of private cloud. Microsoft Azure is dynamic in nature for allocating resources and supports for good security and encryption mechanisms.
Benefits of this application deployment will help learners as well as instructors in many ways. Learners can access portal anywhere and anytime. To go through online courses, reading of material, completion and uploading of assignments can be done outside of campus also. Learners can understand their learning styles and preferences of learning once they can login to application which is running on their organization's private cloud. Instructor can also understand learning styles of the learners and modify or generate different types of learning material in order to satisfy learning styles of learners. In this way learnability of courses will improve which will automatically improve teaching-learning process.

## VI. Conclusion and Future Work

In this paper, the conceptual hybrid cloud architecture for adaptive E-Learning application has been proposed. The paper also tried to focus on seven non-functional requirements which are limitations for E-Learning applications to provide online courses in academic organization. These non-functional requirements can be achieved by collaborating private and public cloud as per the functionality. The architecture not only incorporates the recent benefits of cloud computing by adding hybrid cloud but also provides services which are important for learners as well as instructors to successfully provide online courses on E-Learning portal.
It is expected that with this approach, future E-Learning applications will concentrate on learner's learning styles and adaptive interface for personalization. Personalized recommendation will help learner to identify relevant type of learning material to understand online course. Understanding learning styles improves learnability and improves efficiency of E-Learning application. This proposed method can solve many of the problems of traditional E-Learning systems successfully.
Cloud computing in E-Learning application induces the way that E-Learning could share and distribute the learning resources to any kind of devices and platforms. The learners can access the learning content by using computer, tablet, smartphone, notebook, mobile etc. Cloud platform provides resizable compute capacity based on analysis of end devices which makes web scale computing easier for developers. Since the applications and data are stored into the cloud, the learners can connect to the cloud very fast. Another important benefit is related to cost. Since the E-Learning services are used for a specific time, pay per use of the cloud could reduce the cost. Future work will concentrate on implementation of proposed architecture in real life environment by using Microsoft Azure and Proprietary/Open source Private Cloud of the organization.

## References


[1] B. Dong, Q. Zheng, M. Qiao, J. Shu, and J. Yang, "Bluesky cloud framework: An e-learning framework embracing cloud computing," in *Proceedings of the 1st International Conference on Cloud Computing*. Berlin, Heidelberg: Springer-Verlag, 2009, pp. 577 – 582.

[2] P.-H. Liang and J.-M. Yang, "Virtual personalized learning environment (vple) on the cloud," in *Proceedings of Web Information System and Mining (WISM)*. Springer Berlin Heidelberg, 2011, pp. 403 – 411.

[3] F. Doelitzscher, A. Sulistio, C. Reich, H. Kujis, and D. Wolf, "Private cloud for collaboraton and e-learning services: from iaas to saas," *IEEE Computing*, vol. 91, no. 1, pp. 23 – 42, Sep 2011.

[4] D. Jacobs, "Cloud computing (introduction)," in *Proceedings of IEEE Technology Time Machine Symposium (TTM)*. IEEE, 2012.

[5] P. Paul, A. Felician, and V. Marius, "Using cloud computing for e-learning systems," in *Proceedings of the 8th WSEAS International Conference on Data Networks Communications and Computers*, 2009, pp. 54 – 59.

[6] B. Dong, Q. Zheng, J. Yang, H. Li, and M. Qiao, "An e-learning ecosystem based on cloud computing infrastructure," in *Proceedings of the 9th IEEE International Conference on Advanced Learning Technologies (ICALT)*. IEEE, 2009, pp. 125 – 127.

[7] N. Sultan, "Cloud computing for education: A new dawn?" *International Journal of Information Management*, vol. 30, no. 2, pp. 109 – 116, 2010.

[8] D. R. Herrick, "Google this!: using google apps for collaboration and productivity," in *Proceedings of the ACM SIGUCCS Fall Conference on User Services Conference*. St. Louis, Missouri, USA: ACM, 2009, pp. 55 – 64.

[9] S. Rajam, R. Cortez, E. Vazhenin, and S. Bhalla, "E-learning computational cloud (elc 2 ): Web services platform to enhance task collaboration," in *In the Proceedings of IEEE/WIC/ACM International Conference on Web Intelligence and Intelligent Agent Technology*. IEEE Computer Society, 2010, pp. 350 – 355.

[10] M. Desptovic-Zrakic, K. Simic, A. Labus, A. Milic, and B. Jovanic, "Scaffolding environment for e-learning through cloud computing," *Educational Technology and Society*, vol. 16, no. 3, pp. 301 – 314, 2013.

[11] T. Kaewkiriya and N. Utakrit, "A model of an e-learning management system based on cloud computing and web service," *Information Technology*, vol. 8, no. 1, pp. 83 – 87, 2012.

[12] D. K. Viswanath, S. Kusuma, and S. K. Gupta, "Cloud computing issues and benefits modern education," *Global Journal of Computer Science and Technology Cloud and Distributed*, vol. 12, no. 10, pp. 1 – 7, 2012.

[13] M. Al-Zoube, "E-learning on the cloud," *International Arab Journal of E-Technology*, vol. 1, no. 2, pp. 58 – 64, 2009.

[14] M. Phankokkruad, "Implement of cloud computing for e-learning system," in *Proceedings of Computer and Information Science*. IEEE, 2012, pp. 7 – 11.

[15] M. A. H. Masud and X. Huang, "A novel approach for adopting cloud-based e-learning system," in *Proceedings of the 2012 IEEE/ACIS 11th Conference on Computer and Information Science*. IEEE Computer Society, 2012, pp. 37 – 42.

[16] S.-M. Chuang, K.-E. Chang, and Y.-T. Sung, "The cost effective structure for designing hybrid cloud based enterprise e-learning platform," in *Proceedings of IEEE Cloud Computing and Intelligence Systems (CCIS)*. IEEE, 2011, pp. 523 – 525.

[17] E. J. Qaisar, "Introduction to cloud computing for developers: Key concepts, the players and their offerings," in *Proceedings of IEEE Information Technology Professional Conference (TCF Pro IT)*. IEEE, 2012, pp. 1 – 6.

[18] R. M. Felder and L. K. Silverman, "Learning and teaching styles in engineering education," *Engineering education*, vol. 78, no. 7, pp. 674–681, 1988.

[19] S. Kolekar, S. Sanjeevi, and D. Bormane, "Acquisition of users learning styles using log mining analysis through web usage mining process," in *Proceedings of 3rd International Conference on Intelligent Decision Technologies*. Springer Berlin Heidelberg, 2011, pp. 809 – 819.

[20] S. Kolekar, S. S. Sanjeevi, and D. Bormane, "Learning style recognition using artificial neural network for adaptive user interface in e-learning," in *Proceedings of IEEE Conference on Computational Intelligence and Computing Research (ICCIC)*. IEEE, 2010, pp. 1 – 5.