Journal of Network and Innovative Computing.
ISSN 2160-2174 Volume 3 (2015) pp. 038–046

Deploying Cloud Computing Technology in E-Learning for Malaysian Polytechnic

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Abstract: **Cloud computing (CC) opens up a new paradigm in web-based learning. It promises ubiquitous services, broad network access, a pool of resources, rapid elasticity and its measured service has made this ready-made platform become popular in every field. Nowadays, though this technology has already penetrate into the educational institution, it is still considered at its infancy in the Malaysian Polytechnic (MP) environment. However, e-learning is currently in its optimization phase according to National e-learning Policy, otherwise known as Dasar e-Pembelajaran Negara (DePAN). Reluctance from educators and students in implementing cloud-based e-learning system has become a main concern because of the hindrances brought about by security issues. Security in cloud has been discussed in many previous works and studies. Many solutions have been proposed to strengthen e-learning systems against attacks and threats. Hence, this study aims to reveal the importance of security awareness and knowledge in the e-learning environment. In order to deal with security issues, this paper proposes an architecture which possesses security features in deploying CC which can be implemented by Malaysian educational institutions (especially MP).**

Keywords: cloud computing, education, Malaysian Polytechnic, security awareness, e-learning

I. Introduction

Cloud computing (CC) has become a buzz term because this enhancement paradigm promises numerous benefits for e-services system. E-learning is one of the e-service system branches that began to adopt cloud computing in educational environment. There are a few universities in the United States and Canada already adopting CC in their institutions. For example the North Carolina State University, United States, saves a lot on software licensing costs to support their virtual computing lab. Eastern Washington University in the United States and Lakehead University in Canada have also saved plenty of money by outsourcing their email services. Also, the University of Washington uses the cloud to effectively implement collaborative learning for students at different locations and the Pennsylvania State University, United States, uses CC to share resources among its numerous campuses and colleges [1].

However, in Malaysian education, the deployment of CC in e-learning is still in its initial phase [2]. According to [3], for Higher Education Institution (HEI) such as Malaysian Universities (MU), the focus of implementation of CC is more on the service availability, accessibility and management of the information activities inside MU. Other studies have shown that, there are several obstacles in adopting CC in MU for example; the large number of student's data and information [4].

Despite all the challenges and obstacles, CC is inevitable in making e-learning systems efficient. In order to fulfill Transformation Plan 2010, the Ministry of Higher Education (MOHE) listed e-learning as one of the strengths in empowering the educational channel [5]. As one of the Technical and Vocational Education and Training (TVET) providers in Malaysia, Polytechnic Education Department needs to provide competent graduates in order to fit the employment market needs. Hence, the upgrading of their methods of teaching and learning by deploying CC will optimize e-learning implementation in the coming years.

E-learning can also upgrade basic skills as well as promote research and development projects in collaboration with businesses and industries. The new genre of students need different approaches from the previous education era. In other words, it is essential for Malaysian Polytechnics (MPs) to provide high quality education and equip students for the challenges of the 21st century learning [6].

In order to be equipped with skillfull employers, the government is very much aware that the future of the country does not solely depend on educated personnel, but also on having a large pool of skilled workers that can handle the

rapidly changing world of work for public and private sectors [7]. This paper discusses further on how to achieve our government Transformation Plan 2010 in the following sections. Related work on e-learning deploying cloud computing will be described in Section II. After that, Section III will discuss about the need for security features in MP e-learning system. This section will also give the questionnaire evaluation with results and analysis. Section IV will introduce the proposed architecture for MP's e-learning system and lastly the paper will conclude with the future work in Section V.

II. Related Work

The tremendous growth of internet leads e-learning to grow as a practical medium for teaching and learning. E-learning provides cooperation between computers and networks that deliver skill and knowledge in electronic form, targetted at enhancing the learning process (teaching and learning). Many benefits are brought by e-learning such as convenient content access, cost saving, flexibility in conducting the learning process and supporting personalized learning [8]. However, this method invites a lot of security issues because, cyber environments are vulnerable to attacks and threats [9]. This sections will discuss more about the needs to strengthen MP's e-learning systems and the current state of e-learning in MPs.

A. Deploying Cloud Based in Malaysian Higher Education

CC is *a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (such as networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction* as defined by National International Standard Technology (NIST) [10].

As mentioned in Section I, cloud-based education is becoming more popular among international higher educational institutions. In Malaysia, it is still considered as a new pradigm to be implemented. This ready-made platform promises numerous advantages such as on-demand self-service, broad network access, resource pooling, rapid elasticity and measured service [10].

There is a study on Malaysian education environments that discusses about the advantages of and variety of comparison applications available in cloud applications. This work concludes that security is the main obstruction in adopting cloud in Malaysian higher educational institution. The author suggests that universities must ensure viable vendors are selected to ensure the integrity of information being placed in clouds. Cloud services also should be designed for easier usability with better support than what the users are accustomed to with on-premises computing [3].

According to Hashim (2014), the Malaysian environment is using CC more on service availability, accessibility and management of information and activities compared to apply CC in teaching and learning process medium. However, this author mentions that most challenges leading to the application of CC in MU is the large number of students data and information [4].

As for MPs, the number of students is less than the MU as shown in statistical reports from the Ministry of Education Malaysia, which show that number for universities (including private and public) in the year 2013 are over 100,000 compared to 16,926 for polytechics [11]. This figure might open up the opportunity for changes to adopt CC in polytechnic's education in order to progress in tandem with Transformation Plan 2010.

However, the adopting of CC in polytechnic's environment is not as simple as taking from the existing model or architecture that has been implemented at some other colleges or educational institutions. A thorough research must be conducted to identify the local needs, issues and other related requirements to develop MPs e-learning system. This part will be further discuss in Section II-B.

[12] proposed the framework for cloud based education system as depicts in Figure 1. This framework consists of two main parts, which are the management subsystem and service subsystem:

i) Management subsystem - the lower level which contains hardware, storage and other IT infrastructure and resources pool. This part will solve the sharing of resources using virtualization.

ii) Service subsystem - higher level which serve the software system, maintenance and provision of data, storage medium and e-learning web development integration platform.

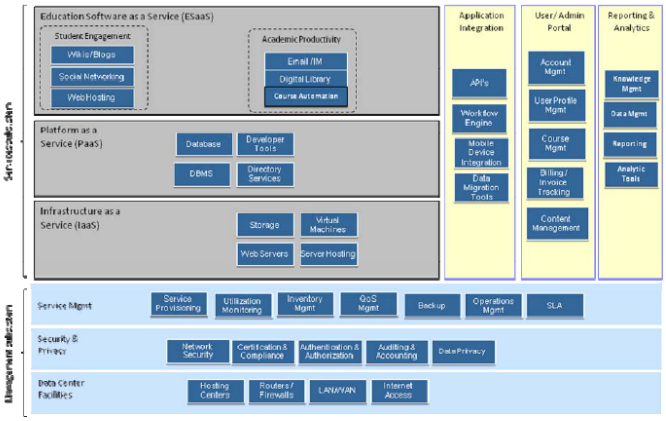

Figure. 1: Framework for cloud-based education system [12]

This architecture can be adopted to MP's e-learning system since according to [12], the above framework shown in Figure 1 been used by e-learning system deployed CC. Hence, the main part from this architecture can be adopted to the MPs environment in proposing an architecture for e-learning system as discussed in the next section.

B. E-Learning in Malaysian Polytechnic

Electronic learning or e-learning is the learning method that uses web as a medium of transfering the knowledge. E-learning systems are widely used in various sectors of teaching which include universities, companies, medical organizations, and even in training schools at a lower level. The main stakeholders involved in e-learning systems are the trainers and students. Students can derive major benefits from an

e-learning environment in terms of efficient media delivery time, timely feedback and communication with teachers. Also, students can communicate interactively with tutors and students anywhere at any time. E-learning providers can obtain more benefits by using the cloud computing infrastructure. Most of the e-learning legacy systems can be adjusted and transferred to cloud data centers to provide more scalable and available applications for students who can be anywhere in the world [13].

In 2013, the Department of Polytecnic Education Malaysia (DPE) took a proactive act to empower e-learning in MPs. This department has established Center for eLearning and Teaching (CeLT) under monitoring Digital Learning Unit from Section Digital Instructional and Learning. CeLT was established to strengthen the agenda of eLearning for all MPs. This department is responsible for managing and asisting the development of the e-learning / blended learning in MPs. The main center is situated in Putrajaya and owns production studio where all Learning Content Management System (LCMS) are being produced at Politeknik METrO Kuala Lumpur.

It was started with the mission to fulfill MOHE's aspiration of moving towards Transformation Plan 2010. This center caters for the first most common thing which is applied in every polytechnic that is Curriculum Information Document Online System or the CIDOS. It contains Competency Standards, Curriculum Inventory, Curriculum Evaluation, Curriculum Review Committee, Teaching & Learning Repository, Learning Management System and Frequently Ask Questions. This online system is mostly used as an alternative medium between students and lecturers to share notes, assignmnet questions, conduct test or quizes and also for assessments tools. This moodle-based online system is considered as a stepping stone to promote e-learning among all MPs.

As mentioned in the report from CeLT (2014), blended learning refers to courses that have a blended approach to learning online and face onsite learning mode with 30% - 80% of the course content and activities being conducted online to either support or replace face to face learning [14]. The term blended learning has various definitions. ColliS and Moonen describe the online component in blended learning as a natural extension of classroom learning [15]. Other authors, Littlejohn & Pegler refer the word 'blend' as the proportion of e-learning content within the course [16]. In Malaysia, blended learning is already discuss in some previous work. Blended learning is used as a tool to make learning more practical instead of too much theoritical concepts in the classroom. This method of teaching encourages students to act as good teamplayers in a group [17].

According to Haryani, blended learning adoption among academicians in Malaysian public universities is still in its initial phase, according to a survey that was conducted. This situation may be caused by the awareness of adopting to e-learning as well, because blended learning combines face to face and online learning in certain proportions [18]. The other study look into student interest in learning and look at the research model that could guide the educators to find the best way of teaching in higher institutions [19].

Blended learning concept that would be practiced in all MP will focus on 21st century pedagogy that combines traditional learning (face to face) and online learning. The department of Polytechnic has determined that 50% of the courses organized by the university must apply on-line components by using a blended learning approach. This implementation commenced in 2014. As depicted in Figure 2 below, MPs seriously act progressively to make sure e-learning is spreading and benefits students, lecturers and indutrial player as well. There are five elements in blended learning (a) lecturers; (b) students; (c) infrastructure; (d) organization and (e) pedagogy. All of these elements as depicted in Table 1 (next page) play their own roles in this environment.

All these aspects must meet the requirements of the concept of 'Flipped Classroom' that is a pedagogical model adopted by CeLT in which the typical lecture and homework elements of a course are reversed. Short video lectures are viewed by students at home before the class session, while class time is devoted to exercises, projects, or discussions.

The lecture's video is the key ingredient in the flipped approach, such lectures being either created by the instructor and posted online or selected from an online storage. While a pre-recorded lecture could certainly be a podcast or other audio format, the ease with which video can be accessed and viewed today has made it so ubiquitous that the flipped model has come to be identified with it [20].

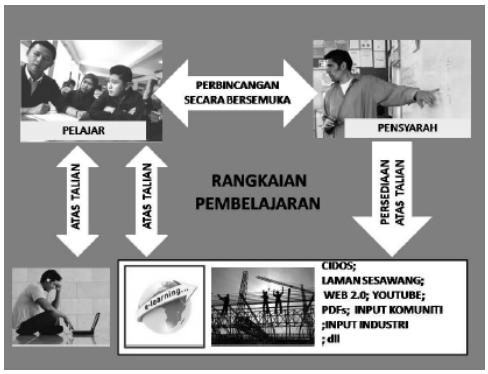

Figure. 2: Internetworking between students and lecturers [14]

Table 1: Main aspects in Blended Learning

Aspect	Description
Lecturer	All lecturers must be equipped with the knowledge and skill aspect for 'Flipped Classroom' concept to manage and control the class effectively
Student	Studnets need to be prepared with culture, mind and IT skills to succeed 'Flipped Classrom'
Infrastructure	Prepare the physical space for classroom that can support to implement 'Flipped Classrom'
Organization	Have a specific structure and policy to make this pedagogy success
Pedagogy	It has to implement 'Flipped Classroom' which must be clearly understood

To conclude this section, in order to map the requirements to adopt e-learning in MPs with the cloud-based environments, several perspectives must be considered such as the people involved, orientation of the systems and also security concerns in the CC. In legacy e-learning system, securi-

ty is still one of the vital elements listed, but in CC, public sharing results in all the data being exposed to threats and attacks. Hence, in the next Section III the architecture for MP's e-learning system deploying cloud computing will be discussed in detail.

III. Security Needs in Malaysian Polytechnic E-Learning System

Although for e-learning, money and profits are not the prior consideration as compared to e-commerce, but the most valuable assets in this web-based learning system are details of student's registration, result and also learning materials that need to be preserved [21]. Hence, e-learning listed the most important security requirements as; confidentiality, integrity, availability, non-repudiation, authentication and privacy [22] which will be discussed more in the next Section III-A.
The previous studies [23] and [24] describe that, in Malaysian education, there is awareness in using e-learning as a platform to enhance the old school style in teaching and learning. Besides the benefits such as online access, ease in maintainance and cost saving, e-learning also creates security issues. About 67.73% students agree that security is a crucial aspect and has been actively applied in ensuring students' satisfaction. This figure was obtained from previous studies on identifying the important aspects of e-service applied in e-learning for HEI in Malaysia.
The following Figure 3 depicts the framework of electronic learning that was proposed by Zazaleena as a reference to ensure success of e-learning systems in Malaysian higher educational institutions. This framework focuses on student's perception as a part of the system and listed 10 elements to ensure success of e-learning: ease of use, appearance, linkage, structure and layout, information, reliability, efficiency, support, communication and security.
From the review papers, we have been exposed to the idea on the importance of security issues in Malaysian e-learning environment. Now, we will discuss in details about the survey regarding security issues via conducting questionnaire session in MPs.

A. Survey on Malaysian Polytechnic

In order to create credible e-learning services, certain elements must be prioritized. Security is one of the vital element for making sure that particular system can be trusted. To reveal the security awareness and knowledge about CC in

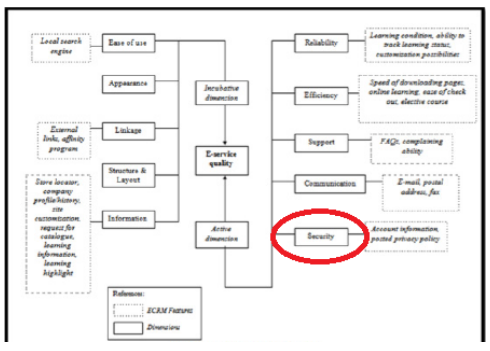

Figure. 3: Framework of Electronic Learning [25]

MPs environment, a study has been conducted using questionnaire distribution among lecturers and students of MPs respectively. This research could be able to envisage the actual situation currently in adapting CC in MP. It focuses for the readiness of all lecturers in MP before CC could be implemented successfully.

B. Objectives

There are two main objectives for this study:

i) to know the general knowledge among MP's lecturers about CC.

ii) to gain the idea of the of level security awareness among MP's lecturers while using CC.

C. Data Sampling

This sample was picked randomly. Out of the 150 questionnaires that were distributed, only 45 were returned by lecturers and the rest from different categories such as student, non-academic staff and others. Also because of restricted geographical area and time limitation, only five Northern polytechnics were successfully collected to complete this initial study. In order to meet the objectives of this paper, that is to know the general knowledge among MP's lecturers about CC and to gain the security awareness level among them, we will only focus on the response from the lecturers. They are the key in implementing this technology in Teaching and Learning (TnL) environment.

D. Data Gathering

The study for this work was conducted by using a survey. 45 respondents from five different Northern MP's lecturers was successfully collected (Politeknik Sultan Abdul Halim Muadzam Shah, Jitra-POLIMAS, Politeknik Tuanku Sultanah Bahiyah, Kulim-PTSB, Politeknik Tuanku Syed Sirajuddin, Perlis-PTSS, Politeknik Balik Pulau, Pulau Pinang-PBU and Politeknik Seberang Perai, Pulau Pinang-PSP). Details about the data gathering are shown in Table 2.

E. Questionnaire Evaluation

The questionnaire had four different components:

i) Part A: the background information of the respondent which include gender, age, role in institution, domain major and experience in the institution. Table 3 shows the details.

ii) Part B: general perception or knowledge about CC. For the likert scale score refer to Table 4.

Table 2: Data Collection

Polytechnic	**State**	**No. of collection**
POLIMAS	Kedah	8
PTSB	Kedah	14
PSP	Penang	5
PBU	Penang	8
PTSS	Perlis	10
	Total	45

iii) Part C: the security awareness using CC. For details refer to Table 4.

iv) Part D: respondents give open comments on security awareness. This part was used as the suggestion to CC users on security awareness.

From Table 3, the ratio between male and female respondents was 42.3:57.7. About 55.6% respondents were in the age of 22 to 35 in comparison to another group from age 36 to 58 years of age who were 44.4%. From 45 respondents, 42.4% were from ICT background and 6.7% were Administration, Electrical Engineering 13.3%, Mechanical Engineering 15.6%, Business Faculty 8.9%, Hospitality 8.9% and others like those who currently on study leave with floating status were 4.4%. The last part of the demography relates to the experience of respondents regarding their services at respective MPs. Most of them have 6 to 10 years (for 48.9%), followed by 37.8% who had more than 10 years experience and only 6 respodents had experience 2 to 5 years experience.

Table 3: Part A: Demography of Respondents

Respondence Profiles	Frequency	Percentage(%)
Gender		
Female	26	57.7
Male	19	42.3
Age		
<= 21	-	-
22 - 35	25	55.6
36 - 58	20	44.4
> 59	-	-
Major of your expertise at the institution		
Administration	3	6.7
Civil Engineering	-	-
Electrical Engineering	6	13.3
Mechanical Engineering	7	15.6
Information and Communication Technology	19	42.2
Business Faculty	4	8.9
General Studied Faculty	-	-
Hospitality	4	8.9
Others	2	4.4
Years of the experience at the institution		
< 1 year	-	-
2 - 5 years	6	13.3
6 - 10 years	22	48.9
> 11 years	17	37.8

Table 5 shows the question regarding general knowledge about CC while the Table 6 shows the question of security awareness on CC. The questions in this part were more advanced compared to part B of the questionnaires.

The items can also be categorized into four groups: perception, readiness, knowledge and security awareness. Figure 4 shows details about each category. These categories are identified based on their response to the questionnaire. These four components help researchers to identify the extensiveness of the technology implemented in one institution [2] [3] [4] [26] [27] .

These instruments were tested using Statistical Package for Social Science (SPSS). To see the reliability of the questions, all 31 questions were tested using Alpha Cronbach method. According to the value of 0.951 of Cronbach's Alpha from Table 7, the questions have been answered and understood well by the respondents. This value also indicates the questions are considered to be reliable.

The second method is by analyzing the data using factor analysis. Table 8 below shows the value Kaiser-Meyer Olkin (KMO) measurement of sampling adequacy. This measurement shows the strength of the relationship among variables (items in questionnaire). The KMO measures for sampling adequacy should be greater than 0.5 for a satisfactory factor analysis to proceed. If any pair of variables has a value less than this, it sould be drop from the analysis. The off-diagonal elements should all be very small (close to zero) for a good model.

For this study, the KMO value is 0.796. It tells that this sample has a strong relationship among the variables. It is a common rule used whenever a researcher has at least 10 to 15 participants per variable. As recommended by Kaiser [28] 0.5 as minimum (barely accepted), values between 0.7 to 0.8 are acceptable, and values above 0.9 are superb. So, the value of 0.796 from this study is acceptable and it is considered that this instrument has a high factor analysis among the items.

Bartlett's test is another part of the test. It is an indicator of the strength of the relationship among variables. This method

Table 4: Likert Scale

Score	Description
1	Strongly Not Agree
2	Not Really Agree
3	Agree
4	Strongly Agree

Table 5: Part B: Perception and knowledge about CC

No	Question : Do you agree if
B1	already know about Cloud Computing?
B2	know how Cloud Computing works?
B3	that Cloud Computing bigger than the Internet?
B4	Cloud computing will give benefits in Malaysian education especially in polytechnic and community college?
B5	have practical experience of cloud computing?
B6	know the cloud computing deployment models?
B7	have an idea about cloud service models?
B8	ever used Google Docs?
B9	Google Docs can change the sharing setting with others?
B10	agree that Google Drive have good and secure store and sharing services?
B11	know about Microsoft Azure,Amazon EC2,Rackspace, Google Compute Engine?
B12	know about AWS Elastic Beanstalk,Windows Azure, Heroku, Force.com, Google App Engine?
B13	used the same password that been used in GoogleDocs for other online application?
B14	already have Google Drive application?
B15	used the share settings in Google Docs when sharing documents or data with anyone?
B16	agree Cloud Computing will help in preparing the effective teaching material by using the application tools provided?
B17	agree Coud Computing driving down the infrastructure for hardware and software cost?
B18	think Cloud can increase interoperability between disjoint technologies within and between institutions?
B19	agree cloud computing can allowed paperless in workload sharing?
B20	Cloud computing can enabling the green environment?
B21	Cloud produce elastic and flexible repository?
B22	agree Cloud computing will removing the admin burden allows educational facilities to concentrate on their core business and be more productive?
B23	agree Cloud computing allowing free access applications and other useful tools?

Table 6: Part C: Security Awareness

No	Question : Do you agree if
C1	the sharing resources is risky?
C2	the repository of your institution contains confidential data?
C3	use network /internet (email or etc) to share important with someone in your institution?
C4	put the password to document/data before share it on network or internet?
C5	share private and confidential document on network /Internet?
C6	sharing in network /internet easier than use the external /USB hard disk?
C7	cloud computing can make this sharing extra benefits?
C8	documents or data that keeps in cloud computing is always safe?

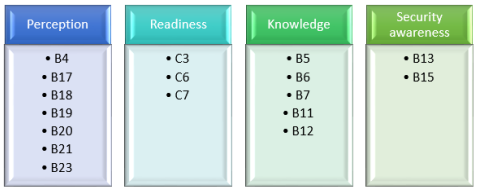

Figure. 4: Categories of items/variables that were used in questionnaire

Table 7: Reliability of the Questionnaire

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	No. of Items
0.951	0.951	31

Table 8: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.796
Bartlett's Test of Sphericity	Approx. Chi-Square	1168.549
	df	276
	Sig.	.000

Table 11: Part D: Comment from respondents

# Respondent	Comment
R3	always make backup for the data and set certain level for user.
R10	do not clearly understand the concept of CC
R47	make extra storage
R63	frequently change the password and do encryption
R125	use encryption technique before end of receiving data or document

tests the null hypothesis that the correlation matrix is an identity matrix. An identity matrix is a matrix in which all of the diagonal elements are 1 and all off-diagonal elements are 0. From the table, we can see that the Bartlett's test is 0.000. So we have to reject the null hypothesis. This means that the correlation matrix is not an identity matrix. Thus, this instrument shows that there are strong relationships among the variables (questions) and are also reliable to be used as tools in this study. After evaluating the instruments, the next section will discuss about the result analysis from this study.

F. Result and Analysis

Table 9 lists the mean value for each item in the questionnaire. By using Table 10 to determine the mean value, three indicators have been used. From the SPSS calculation for the likert scale, it represents low for a mean 1 to 1.33, moderate from 1.33 to 2.66 and high from 2.67 to 4. As shown in Figure 5, the mean value consists of two parts, high (> 2.67) and moderate (1.34 to 2.66).

For perception and readiness, the mean value shows a high value in the range of 2.67 till 2.96. There are seven items for perception and three for readiness. With this value, we can assume there is positive response from MP lecturers in terms of perception and readiness towards acception and adoption of CC in their institution.

However, there is still a part lacking. The moderate mean value revealed something related to the knowledge and security awareness among the MP lecturers. Some of the lecturers need to improve their knowledge regarding CC and then they can be alert to the security awareness that is associated to it. The highest mean value is shown in perception category. It has a 2.98 score for mean value which shows that respondents agree that CC can support the flexible and elastic repository. For the lowest mean value it shows in knowledge category which is 1.51.

Table 10: Indicator of Mean value

Mean	Indicator
1 - 1.33	Low
1.34 - 2.66	Moderate
2.67 - 4.00	High

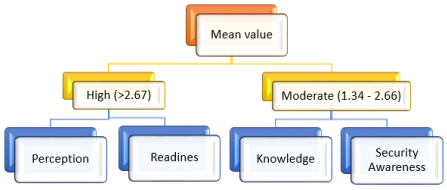

Figure. 5: Mean value for variables

This study also showed that some respondents are not really familiar with CC. They do not have basic knowledge about CC as shown in Table 11. This part consists of the open comment from respondents. From the respondents' comments, it shows that they are more concerned about the safety of the data that is being sent to cloud in term of privacy, reliability and authentication. This is the common issue among researchers; inventing the latest ideas and methods to overcome security issues. But somehow, we need to remember, sometimes the user is the key in keeping data safe. The user or the people who use the system or application should be exposed to the knowledge of that technology, so that they will be aware of security issues and so on.

CC can be a tool to enhance the current application that has already been implemented in the Polytechnic transformation plan such as e-Learning and blended learning. However, this can only be realized if CC is widely accepted in the institution. Therefore, the output from this study can be used as an aid for proposing an architecture to adopt CC in MPs e-learning system. The exposure among lecturers and students can help in expanding the technology in MP and Malaysian education generally. Next sub section will propose the architecture for MPs e-learning system with consideration for security as the vital part since it will be deploying CC as a platform.

IV. Proposed Architecture

The informations from the concept of e-learning in MP in Section II-B and the results from the survey in Section III-F are gathered in order to propose an architecture for e-learning system deploying CC environment for MP as depicted in Figure 6. This architecture was also adopted from the framework for cloud-based education system (refer Figure 1) which consists of three main parts:

a) People (user) - which consists of students, lecturers, administrator (LCMS) and the institution itself.

b) Management Cluster - contains the security and privacy system that makes this system trustworthy and data center facilities which are responsible for maintaining LAN/WAN connectivity.

c) Service Cluster - consists of the three main services layers in CC (Software as a Service layer (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS).

A. People or users

In MPs, blended learning as previously mentioned has two main users: students and lecturers. Both users play their own roles as the system's users. Students will be equipped with

Table 9: Result from questionnaire:Mean

#	Items	Mean
B1	already know about the cloud computing	2.44
B2	know how cloud computing works	2.16
B3	that cloud computing bigger than the Internet	2.23
B4	cloud computing give benefits Malaysian education especially for polytechnic and community college	2.93
B5	have practical experience of cloud computing	1.67
B6	know the cloud computing deployment models	1.77
B7	have an idea about cloud computing service model	1.67
B8	ever used Google Docs	2.29
B9	Google Docs can change the sharing setting with others	2.2
B10	that Google Drive have good and secure and sharing services	2.18
B11	know about Microsoft Azure,Amazon EC2, Rackspase, Google Compute Engine	1.56
B12	know about AWS Elastic Beanstalk, Win Azure, Heroku,Force.com, GoogleApp Engine	1.51
B13	used the same password that been used in GoogleDocs for online application	1.56
B14	already have Google Drive application	2.22
B15	used the share settings in Google Docs when sharing documents or data with anyone	1.89
B16	agree cloud computing will help in preparing the effective teaching material by using the application tools provided	2.42
B17	agree cloud computing driving down the infrstructure for hardware and software cost	2.67
B18	cloud can increase interoperability between disjoint technologies within and between institutios	2.76
B19	cloud computing can allowed paperless in workload sharing	2.89
B20	cloud computing can enabling green computing	2.87
B21	cloud produce elastic and flexible repository	2.96
B22	cloud computing will removing the admin burden allows educational facilities to concentrate on their core business and be more productive	2.62
B23	cloud computing allowing free access applications and other useful tools	2.76
C1	the sharing resources is risky	2.42
C2	the repository of your institution contains confidential data	2.53
C3	use network /internet (email or etc) to share important with someone in your institution	2.8
C4	put the password to document/data before share it on network or internet	2.64
C5	share private and confidential document on network /Internet	2.24
C6	sharing in network /internet easier than use the external /USB hard disk	2.93
C7	cloud computing can make this sharing extra benefits	2.91
C8	documents or data that keeps in cloud computing is always safe	2.4

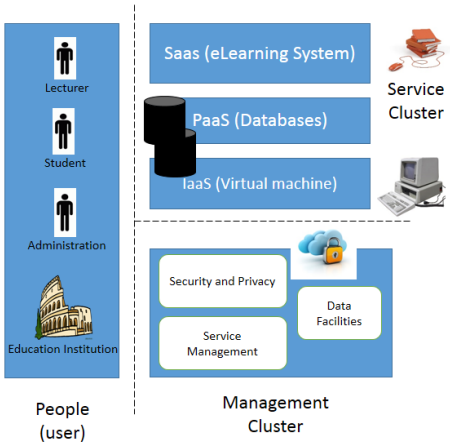

Figure. 6: Proposed architecture for e-learning system deploying the cloud computing environment for Malaysian Polyetchnic

the knowledge of 'Flipped Classroom' and also about CC. They need to be exposed to cloud environment in order to use the system well. Besides these two main actors, there are also administrative user and institutional users. Administrative users include people who work in the administration side such as officers from CeLT, CIDOS officer, content manager, multimedia officer and those who are directly involved in the center especially officers from DPE. For institutional users, it involves the e-learning officers who are responsible for updating news from center during meetings and also multimedia officers to help in developing the content with content manager.

B. Management Cluster

The three main divisions in the management cluster (Data Facilities, Security and Privacy and Service Management) focus on ensuring scalability and efficiency of resource usage for cloud computing. This cluster more attach to physical resources, like hardware, storage and pheripherals infrastructure and pool of resources, it will cater towards solving the sharing of computing resources as such store data from e-learning library. Management cluster also supports the network environment with supplies to the computing and storage for the higher level with basic service-oriented architecture (SOA). This part consists of network security, certificate compliance, authentication and authorization, auditing and accounting and data privacy. For this stage, the security practices can be applied such as usernames and passwords and filters in the network. This layer also connects to the next service layer.

C. Service Cluster

This part is incharge of external provision of services. From SaaS layer it will manage the software system itself. This layer will deal with all applications and sofware applied in one institution, such as email hosting, digital library, module, web hosting, social networking and others. This part is critical for sharing and public users. So, SaaS needs more control to evaluate user trust in e-learning system. PaaS will focus more on storage and database maintenance. If there is a need for developer tools or directory services, this layer will do this. For last layer IaaS, it will serve web server and hosting server for institution. This part is also connected from the management cluster which filter the security and privacy from the service cluster. At this part, implementation such as encryption technology for storage and transmission is suitable for application. This part needs to be more secure from the provider. So, usually this part will apply more security

policies from the institution to authenticate and permit access because the whole e-learning system run by this section. As mentioned from the survey in MPs [29], security is the vital element in protecting MPs e-learning system. MPs need to carefully appoint a trustworthy service provider based on their reputation, policy or evidence of their background.

V. Conclusion and future work

Security concerns are still the main hindrance in the deployment of CC in education institution. Although this ready-made platform can benefit educatioaln institutions, the adoption of CC is still doubtful. Hopefully, the proposed architecture from this study can benefit Ministry of High Education especially MP in mapping the requirements for e-learning to move to next generation e-learning based on CC. Security must be one of the main consideration but not the hindrance in adopting CC in e-learning systems. The Malaysian government dreams in achieving Transformation Plan 2010 in order to optimize e-learning in MP education environment which will be facilitated by this architecture. For consideration in future works, a trust management system might be applied so as to strengthen e-learning system in an all-inclusive perspective.

Acknowledgment

This work is supported by the Ministry of Education (MOE), Malaysia and UTM under Vote No. (4L108). In addition, grate gratitude goes to the MP's lecturers from Northern Malaysia who were co-operative in the survey carried out using questionnaires.

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