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CLOUD COMPUTING OPPORTUNITIES: ENHANCING INTERACTIVE VISUAL CONTENT USAGE IN HIGHER EDUCATION LEARNING

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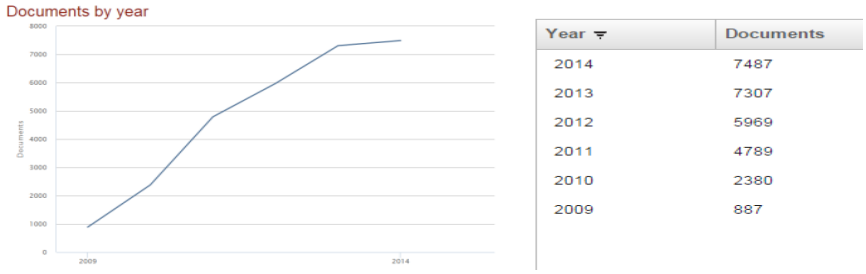
Abstract

Visual content in learning material most commonly found in schools learning materials and less in higher education learning. Students in universities and colleges are dependent on wordy textbook and lecture notes to study. Use of visual contents depends on educator's interests, needs and willingness to provide the material to students. Nowadays, learning started to emerge at a rapid pace in producing learners with excellent academic achievements. The role of cloud computing hence increases the capability of delivering education from educator's perspectives. The purpose of this paper is to highlight important features of cloud computing in enhancing the use of interactive visual content in higher education learning and promotes interactive learning to students. Systematic Literature Review (SLR) method is used to obtain primary data from online databases Scopus and by using the coding procedure in Grounded Theory(Strauss & Corbin, 1990), research produces meta-model data of codes extractions from primary data. Findings shows there are four major abstractions of cloud features that lead to enhancing interactive visual content use in higher education.

Keywords: Cloud Computing; Interactive Visual; e-learning; Grounded Theory

1 INTRODUCTION

The teaching and learning processes in higher education focus on the deliverance of compact structured contents to students; and are traditionally delivered through heavily text-driven textbooks. In recent years, newer learning mediums and approaches have been introduced to help in accelerating learning processes. The emergence of the internet opens up to a new era of learning and changes the way students learn and react towards unfamiliar subjects. Additionally, the advent of cloud computing in pedagogy provides added opportunities for educators to create interactive learning materials for students and enables them to share learning materials with a larger pool of viewers. Interactive learning materials may include the use of visuals. Visuals have been used for decades in aiding learning processes whereby various types of visual representations such as diagrams, images, graphs, sketches, interactive visuals, maps, and objects are typically used (Burkhard, 2004). Since today's educational environment forces learners to master topics in shorter durations of time, the roles of visuals in learning materials are becoming more crucial. They hold a significant part in improving the efficiency of learning processes by accelerating student's understanding (Gu, Ahmad, & Sumner, 2010), (Zhang, Zhong, & Zhang, 2010). From 2010 onwards, research in cloud computing has expanded rapidly especially in the fields of computer sciences and engineering (See Figure 1).



Year	Documents
2014	7487
2013	7307
2012	5969
2011	4789
2010	2380
2009	887

Figure 1. Cloud Computing Related Research 2009-2014 (Source: Scopus Published Journals, Conference Paper, and Proceedings)

In this paper, we are looking into cloud opportunities in education where we are focusing on features of cloud that can enhance interactive visual content usage to aid learning in higher education. The online database, Scopus is selected in this research to construct a meta-model using Grounded Theory.

2 LITERATURE REVIEW

2.1 Cloud Computing

The rapid adoption of cloud computing in various industrial fields has popularized its usage over the past few years. National Institutes of Standards and US Department of Commerce Technology (NIST) in 2011 has defined cloud computing as '*A model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. A cloud model is composed of five essential characteristics, three service models, and four deployment models*.' Whereas, a cloud service model includes Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS).

Cloud technically promotes 'low-cost service' to end users where all kind of services can be found online and people can easily subscribe to any service that they wanted in no time or boundary limits. The idea of sharing or putting information online to a third party vendor seems to enable knowledge

exchange and increase knowledge transfer among a bigger pool of online users besides its low-cost advantages to companies or individuals.

2.2 Interactive Visual Content

Interactive visuals have wide-ranging explanatory definitions in research especially from the fields of computer science and education. As defined by Burkhard (2004), they may consist of media, coursework, videos, games and many others. Interactive visualization can also be defined as computerized image in which users can personally manipulate and communicate with the material. It is mostly used in learning processes to enhance students' learning capability and long-term memory. People use various tools to create interactive visualization objects.

2.3 Grounded Theory

Back in 1967, Glaser and Strauss introduced Grounded Theory. This theory facilitates 'the discovery of theory from data'. The data extracted from collected fields will be used to formulate a new theory rather than focusing on testing the hypothesis based on existing theoretical framework (Dunne, 2011).

Strauss and Corbin (1990) highlighted some guidelines for coding data when using Grounded Theory.

There are three coding procedures;

2.3.1 Open Coding

'The process of breaking down, examining, comparing, conceptualizing, and categorizing data'

2.3.2 Axial Coding

'A set of procedures where data are put back together in new ways after open coding, by making connections between categories. This is done by utilizing a coding paradigm involving conditions, context, action/interactional strategies and consequences'

2.3.3 Selective Coding

'The process of selecting the core category, systematically relating it to other categories, validating those relationships, and filling in categories that need further refinement and development'

3 METHODOLOGY

This research employs Systematic Literature Review (SLR) in obtaining primary data. This method is effectively carried out by collecting relevant articles based on predefined search query (Kitchenham et al., 2009). There are four steps in SLR;

3.1 Definition of Research Question

Research questions are generally set up based on research objectives. This paper aims to highlight the opportunities of cloud computing in improving the usage of interactive visuals. The research question that leads to the desired objective is: What are the important features of Cloud Computing that should be considered to enhance the use of interactive visual content in higher education?

3.2 Search Strategy

The online database, Scopus is selected as the input data source because this database contains all the indexed papers and it is provided freely from Universiti Teknologi Malaysia (UTM) Online Databases Library. It is easy to access and allows direct access to abstract and full paper view. Some papers that do not allow full view are obtained from Google Scholar. The search query is conducted based on the research question and it consists of the combination of several keywords and Boolean operators. A search query by definition identifies the specific aim followed by the generalize query. Here we choose 'cloud computing' as first input query followed by 'higher education learning'.

3.3 Study Selection

After running an input query to the selected database, a set of relevant articles is collected. The titles, abstract and full text of each article are then read one by one to eliminate unrelated articles from the actual relevant articles. Reading of title and abstract may fasten the elimination process. All steps are considering the two sets of selection criteria; inclusion criteria and exclusion criteria. A list of inclusion criteria used to identify the primary study is listed in Table 1. Whereas, the list of exclusion criteria used to eliminate articles that are irrelevant to our needs is listed in Table 2. After this process, primary data for the actual set of relevant data is ready for the next steps which to extract codes from articles to form clustered code.

No.	Criteria
1.	Cloud computing in learning environment
2.	Higher education learning related
3.	Software as a Service related
4.	Journals, Proceedings from the year 2010 – 2015
5.	Computer and education title
6.	Article related to interactive visual

Table 1. Inclusion Criteria

No.	Criteria
1.	Interactive visual is not primary requirement
2.	Infrastructure and platform not related
3.	Missing study source
4.	Lecture note, book, book chapters not included
5.	E-learning and higher education not primary topic

Table 2. Exclusion Criteria

3.4 Primary Study Management

After running search query ['cloud computing' AND 'higher education learning'] we manage to get 131 relevant articles for this research. After exclusion based on the title, we identify 86 articles and it reduces to 68 after considering the abstracts. Reading of full text brings down to 34 relevant articles for our next process. These sets are the only articles that specifically related and contributed to the primary data collection. All data are stored in EndNote X7.

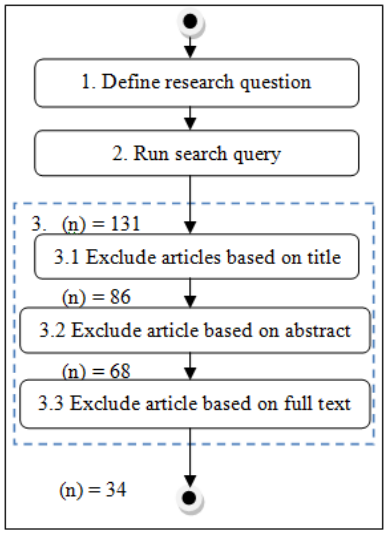


Figure 2. Summarize of SLR steps

Figure 2 shows the summarization of SLR steps. (n) is the number of remaining articles after going through phases of selection. In our study selection, there are six inclusion and five exclusion criteria considered, (refer Table 1 and Table 2 in Section 3.3). Throughout the steps, we independently identify and eliminate articles that do not match our needs based on mentioned criteria.

4 FINDINGS AND DISCUSSIONS

Strauss (1990) coding is used as one of the methods to analyze data. Articles are summarized and coded into the most simple and meaningful words. All the codes from the primary data are then clustered based on the relations between concepts of codes to produce a pattern. The clustered codes from primary data are categorized as; Cost Effective; Response Time; Motivation; On-demand-service; Knowledge Transfer; Interest; Academic Achievement; Self-learning; Data Security/High Reliability; Accessibility/Communication; Sharing/Eliminate Redundancy; Ease of use. The details are shown in Table 3.

Title /Author	Clustered Code	No. of Article
1. (Chandra & Borah, 2012). Cost-Benefit Analysis of Cloud Computing In Education 2. (Ambrose, 2013). Optimization of Resource Usage for Computer-Based Education Through Mobile, Speech And Sky Computing Technology. Creating Global Competitive Economies: 2020 Vision Planning and Implementation 3. (Chandran & Kempegowda, 2010). Hybrid E-Learning Platform Based on Cloud Architecture Model: A Proposal 4. (Kratzke, 2012) . Are Cloud Enabled Virtual Labs Economical?: A Case Study Analyzing Cloud-Based Virtual Labs For Educational Purposes. 5. (Lin, Wang, Cai, & Li, 2014). Design and Development of Education Cloud Platform. 6. (Mahalingam & Rajan, 2013). Cloud and Mobile Computing: Affordances of the 21st Century Teaching and Learning. 7. (Masud & Huang, 2013a). ESaaS: A New Software Paradigm for Supporting Higher Education in Cloud Environment 8. (Morgado & Schmidt, 2012). Increasing Moodle Resources Through Cloud Computing. 9. (Mosbah, Alnashar, & El-Nasr, 2014). Cloud Computing Framework for Solving Egyptian Higher Education	Cost Effective	12

10. (Muniasamy, Ejalani, & Anandhavalli, 2014). Moving Towards Virtual Learning Clouds From Traditional Learning: Higher Educational Systems in India. 11. (Okai, Uddin, Arshad, Alsaqour, & Shah, 2014). Cloud Computing Adoption Model for Universities to Increase ICT Proficiency. 12. (Shuai, 2011). What Will Cloud Computing Provide for Chinese M-Learning?		
1. (Alharbie, Athauda, & Simon, 2012). An Analysis of Students' Perspectives in Using Virtual Labs in an Undergraduate IT Course 2. (Jarraya & Khedher, 2015). A High Performance Cloud Computing Solution for Training and Laboratories	Response time	2
1. (Jou & Wang, 2012). Observations of Achievement and Motivation in Using Cloud Computing Driven CAD: Comparison of College Students with High School and Vocational High School Backgrounds.	Motivation	1
1.(Ambrose, 2013). Optimization Of Resource Usage for Computer-Based Education Through Mobile, Speech and Sky Computing Technology. Creating Global Competitive Economies: 2020 Vision Planning and Implementation 2. (Benson & Morgan, 2012). Student Experience: Issues of Wireless Access and Cloud Deployment in Higher Education 3. (Chunwijitra, John Berena, Okada, & Ueno, 2013). Advanced Content Authoring and Viewing Tools Using Aggregated Video and Slide Synchronization by Key Marking For Web-Based E-Learning System in Higher Education. 4. (Fong & Wong, 2015). A Personal Assistant Authoring E-Book For E-Learning in Higher Education Using Inverted Files of Hyperlinks. 5. (Kihara & Gichoya, 2014). Use of Cloud Computing Platform For E-Learning in Institutions of Higher Learning In Kenya 6. (Lee, 2015). Authentication Scheme for Smart Learning System in The Cloud Computing Environment. 7. (Masud & Huang, 2013a). Esaas: A New Software Paradigm for Supporting Higher Education in Cloud Environment 8. (Molto & Caballer, 2015). On Using The Cloud To Support Online Courses. 9. (Muniasamy et al., 2014). Moving Towards Virtual Learning Clouds From Traditional Learning: Higher Educational Systems in India. 10. (Okai et al., 2014). Cloud Computing Adoption Model for Universities to Increase Ict Proficiency. 11. (Perramon, Alemany, & Panadès, 2014). Use of Mobile Collaborative Tools for The Assessment of Out-Of-Classroom Courses in Higher Education Cloud Technologies Applied to The Monitoring of The Practicum 12. (Wang, Chen, & Khan, 2014). Mobile Cloud Learning for Higher Education: A Case Study of Moodle in The Cloud.	On-demand-service	12
1. (Alharbie et al., 2012). An Analysis of Students' Perspectives in Using Virtual Labs in An Undergraduate IT Course	Knowledge Transfer	1
1. (Basal & Steenkamp, 2010). A Saas-Based Approach in An E-Learning System.	Interest	1
1. (Chiu, 2014). The Application of A Cloud-Based Student, Teacher, and Parent Platform in English as A Foreign Language Education. 2. (Doan, Zhang, Tjhi, & Lee, 2011). Analyzing Student's Usage of E-Learning Systems In The Cloud for Course Management. 3. (Mosbah et al., 2014). Cloud Computing Framework for Solving Egyptian Higher Education. 4. (Jou & Wang, 2012). Observations Of Achievement And Motivation in Using Cloud Computing Driven CAD: Comparison of College Students With High School and Vocational High School Backgrounds.	Academic Achievement	4
1. (Chunwijitra et al., 2013). Advanced Content Authoring and Viewing Tools Using Aggregated Video and Slide Synchronization by Key Marking for Web-Based E-Learning System in Higher Education. 2.(Morgado & Schmidt, 2012). Increasing Moodle Resources Through Cloud Computing. 3. (Muniasamy et al., 2014). Moving Towards Virtual Learning Clouds From Traditional Learning: Higher Educational Systems in India. 4. (Ramachandran, Sivaprakasam, Thangamani, & Anand, 2014). Selecting A Suitable	Self-learning	4

Cloud Computing Technology Deployment Model for An Academic Institute: A Case Study.		
1. (Gopinath & Geetha, 2013). An E-Learning System Based on Secure Data Storage Services in Cloud Computing. 2. (Lee, 2015). Authentication Scheme for Smart Learning System in The Cloud Computing Environment. 3. (Lim, Grönlund, & Andersson, 2015). Cloud Computing: The Beliefs and Perceptions of Swedish School Principals. 4. (Sarrab, Alalwan, Alfarraj, & Alzahrani, 2015). An Empirical Study on Cloud Computing Requirements for Better Mobile Learning Services.	Data Security/ High Reliability	4
1. (Griffiths, 2011). Flexible Learning Support in An Inflexible Society. 2. (Masud & Huang, 2013b). A Cloud Based M-Learning Architecture for Higher Education. 3. (Nan Cenka & Hasibuan, 2013). Enhancing Educational Services Using Cloud Technology. 4. (Sarrab et al., 2015). An Empirical Study on Cloud Computing Requirements for Better Mobile Learning Services. 5. (Shuai, 2011). What Will Cloud Computing Provide for Chinese M-Learning?	Accessibility /Communication	5
1. (Li, Wang, & Zhang, 2014). Research on The Basic Education Resources Sharing Model Based on Cloud Computing. 2. (Lim et al., 2015). Cloud Computing: The Beliefs and Perceptions of Swedish School Principals. 3.(Morgado & Schmidt, 2012). Increasing Moodle Resources Through Cloud Computing. 4. (Mosbah et al., 2014). Cloud Computing Framework For Solving Egyptian Higher Education 5. (Muniasamy et al., 2014). Moving Towards Virtual Learning Clouds from Traditional Learning: Higher Educational Systems in India. 6. (Paul & Dangwal, 2014). Cloud-Based Educational Systems and Its Challenges and Opportunities and Issues. 7. (Sarrab et al., 2015). An Empirical Study on Cloud Computing Requirements for Better Mobile Learning Services.	Sharing/ Eliminate Redundancy	7
1. (Sarrab et al., 2015). An Empirical Study on Cloud Computing Requirements for Better Mobile Learning Services.	Ease of Use	1

Table 3. Cluster of Cloud Features

4.1 Simplify Clustered Codes

Four major abstractions from codes are simplified from the clustered codes. Abstraction components named into four major classes that are suitable. We chose Technology, Constraint, Individual and Requirement to develop a meta-model for this research. Table 4 shows the summarization of abstraction codes.

Technology	Individual	Constraint	Requirement
• Response Time • Ease of Use • Sharing/Eliminate Redundancy • Accessibility/Communication • Cost Effective • On-demand-service	• Motivation • Interest	• Data security/high reliability	• Self Learning • Academic Achievement • Knowledge Transfer

Table 4. Summarization of Abstraction Codes into Classes

4.2 Meta-model Creation of Cloud Computing Features in Enhancing Interactive Visual Usage in Higher Learning Education

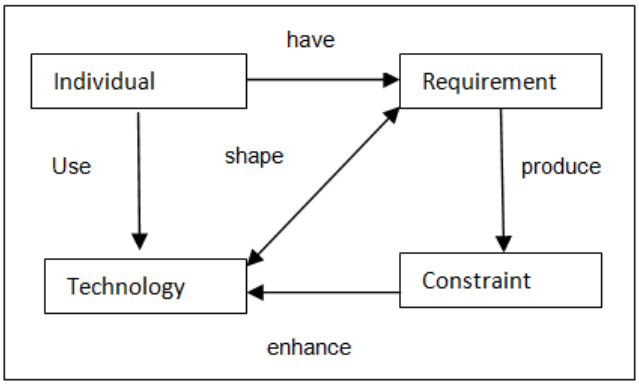


Figure 3. Illustration of Meta-Model for Cloud Features

The relation between the four classes in meta-model is determined from the collectives codes of the cloud features as shown in Table 3. These are drawn in XMind7 to visualize its relation based on identified pattern from the final related articles and revised to fit enhancement of interactive visual usage in the higher learning context.

4.3 Benefit of Cloud Computing

Interactive visual content can help a lot in shaping learning techniques and attract students to learn in a different environment. Individual constraint plays a big role in identifying the use of interactive content in learning. Cloud seems to give a push technology allowing educators and students to enjoy the available technology in a more convenience way since there are a lot of learning tools and software available and shared online. Based on this study, we found that there are several important features of cloud that need to be considered including technology readiness, individual willingness, requirement and constraint such as security of data when considering cloud to enhance interactive visual content for higher education learning. Cloud helps in reducing maintenance cost, shorten learning time, promote knowledge transfer and improve academic achievement for students. It also allows easy access to documents where it can be used anytime and anywhere while promoting self-learning to students and give chances for long distance learning. Some other benefits from cloud technology are when it can be used as a medium for communication.

5 CONCLUSION

There are certain criteria that should be called to attention when applying cloud computing, namely: security concerns, and issues of data reliability and authenticity. Cloud computing has been used by almost everyone whether they realize it or not. In the education field, it is very crucial and convincing to consider optimizing cloud usage as it offers lots of benefits despite some risks and threats. This research highlights that there are four major components that need to be considered when applying cloud to enhance interactive visual content usage in higher learning as presented in the meta-model. Future research can consider using other databases to improve the proposed model since articles were taken from a single database only.

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