A Conceptual Framework for Cloud-based Collaborative Online Course Provision

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ABSTRACT
A cloud-based collaborative environment for online course provision between universities can facilitate a cost-effective, efficient and enriched education enabling good student experience. However, there are a number of challenges and issues that should be taken into consideration prior to adopting the collaborative environment. They relate to management and administration, cost, collaborative Virtual Learning Environment, ownership, development of courses and teaching resources, as well as culture. To address these challenges a conceptual framework is proposed for this environment which highlights key issues and associated relationships between them. The framework contains five main elements, including Quality, Legal, Security, Operation and Education. The framework illustrates the relationship between the elements. A prototype is also discussed which was designed to test part of the framework.

CCS Concepts
• **Social and professional topics → Computer supported cooperative work** • **Social and professional topics → Computing education**

Keywords
Cloud-based collaborative online course provision; cloud-based collaborative environment; Relationship between elements; prototype for cloud-based collaborative environment;

1. INTRODUCTION
The concept of collaboration is an essential form of human activity which enhances working in a group to achieve shared goals [1]. Collaborative online learning improves communication skills between students and provides opportunities to improve their teamwork skills [2]. Collaborative teaching provides opportunities to academics to share experience and learn from teaching methods from each other [3]. Further, it enables instructors and academics to share teaching resources [4].

With significant improvement in Information and Communication Technology (ICT), cloud computing has become a new platform for enabling ubiquitous computing and access to computing resources on-demand [5]. Cloud computing has provided many benefits to higher education institutions and can be used to reduce IT expenses [6]. Cloud computing can facilitate collaborative environments by providing sharing IT resources and services. Its availability, scalabilities, accessibility and flexibility make it an appropriate environment for collaborative working [7]. Cloud computing can enhance and support online collaborative learning activities [8]. A key facility it can provide is a collaborative virtual learning environment, which traditionally was made available by each university independently.

Challenges and issues for a cloud-based collaborative online course provision between universities have been explored in [9]. They include culture, joint development of courses and teaching resources, operational issues, awarding body, copyright and ownership [9]. This paper further explores the challenges and proposes a framework which highlights the key elements associated with this collaborative environment and the relationship between them.

The paper is organized as follows: Section 2 discusses the relevant research. Section 3 presents the research methods. Section 4 presents the proposed framework for a cloud-based collaborative environment for online course provision. Section 5 presents the prototype to test part of the framework. Section 6 presents the conclusion of the paper.

2. RELATED WORK AND BACKGROUND
The review of the literature revealed a number of benefits and issues associated with cloud-based collaborative environments in education which are discussed below.

2.1 Collaborative Learning Environment
Collaborative learning gives students opportunities to improve their critical thinking [10]. Online collaborative learning plays an important role in motivating students to participate and share their knowledge with peers in online discussion forums. In such an environment, students feel they belong to the learning community [11]. Engaging with collaborative tasks can help students to improve deeper understanding of topics [12]. Some researchers indicate that online collaborative learning can reduce the feeling of isolation, thereby lowering the risk of withdrawal from the course by students [13].

Virtual computer laboratories can support a collaborative environment enabling students to share their practical work with other participants and also encouraging remote communication between them [14]. However, collaborative learning environments

can also have a negative effect. For example, some students are not confident enough to raise questions in online discussion forums. In addition, some students may feel uncomfortable to communicate with peers or joining group works [12].

2.2 Cloud Computing in Higher Education Institutions

Cloud computing provides a number of benefits to the Higher Education Institutions. There are a number of educational institutions adopting cloud computing due to flexibility, scalability and reliability and seeking to reduce IT cost. Cloud computing provides opportunities to improve efficiency for the educational institutions [15]. Cloud computing enables users to access virtualized resources containing server, storage, applications and network. Cloud computing enables access to online services anywhere and enhances the availability of online applications [16]. Cloud computing supports the delivery of applications via the internet, with no need for installation and maintenance of the software [15].

Cloud computing delivers hardware and software as a service via the internet. The software will be updated automatically in the cloud [17]. Virtual laboratories can be improved by using the cloud, thereby renewing physical resources and reducing the complexity of management. The cloud-based virtual laboratories will be available 24/7 [18]. These benefits can attract universities to migrate their IT infrastructure to the cloud [15].

3. RESEARCH METHDOS

Exploratory sequential mixed research methods [19] were used to investigate the issues for developing a cloud-based framework for a collaborative environment for online course provision. The research was adopted in two phases. In the first phase, academic and administrative staff who had been involved in online courses were interviewed. This was followed in the second phase by running using two separate surveys for academics and students.

In the first survey, qualitative data was collected to identify the challenges and issues that should be considered by universities when adopting the framework. The interviews were analysed using the thematic analysis proposed by Braun and Clarke [20]. Seven themes emerged from the analysis of the interviews. They are culture, management and administration, technical issues, development of teaching resources, collaborative VLE, operational and rights.

Subsequently, quantitative data was obtained to investigate further, generalize and test the challenges and issues that emerged from the first phase. The surveys were administered using a web-based tool (Smart Survey) [21]. Descriptive statistical analysis was used to summarise and describe a large amount of data which was collected. New issues emerged from the surveys, which are Quality, Legal, Security, Operation, and Education. All the issues which have emerged from the surveys and the interviews were incorporated into the framework.

4. CONCEPTUAL FRAMEWORK FOR CLOUD-BASED COLLABORATIVE ONLINE COURSE PROVISION

This paper presents a conceptual framework for a cloud-based collaborative environment for online course provision between universities. The framework includes five main elements. Each element can expand into a number of sub-elements. The framework illustrates the relationship between the elements. The

elements are Quality, Legal, Security, Education, and Operation. The framework is shown in figure 1.
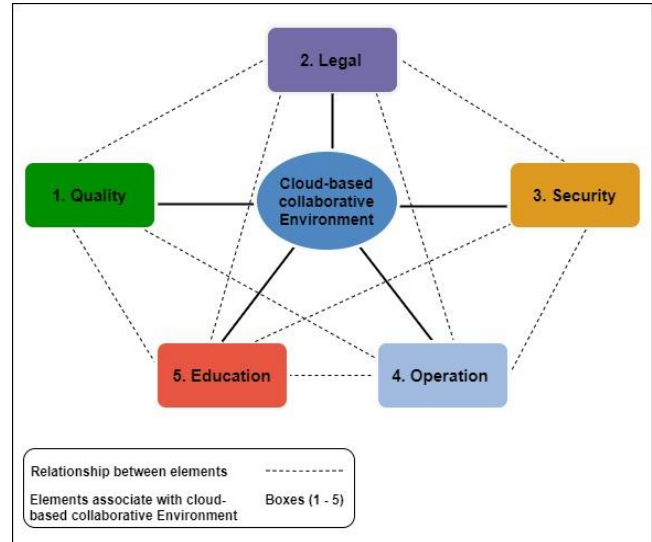

Figure 1. A conceptual framework for cloud-based collaborative online course provision.

4.1 Quality Element

There are a number of issues which are associated with quality assurance, accreditation and academic standards. Quality assurance relates to both operation and education, as shown in figure 2. Universities normally have their own quality assurance procedures and processes. Therefore the universities involved in collaboration need to agree to adopt the processes of one of the universities or create processes and procedures specifically for the collaborative environment.
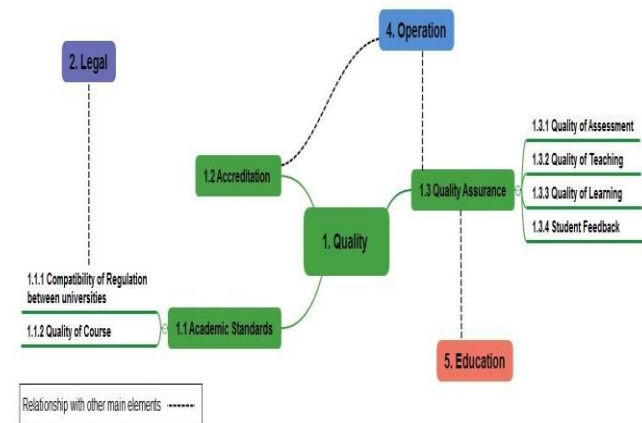

Figure 2. Quality Element

4.2 Legal Element

There are a number of legal issues which are incorporated in the framework. They include contract agreement, rights, and ownership, as shown in figure 3. Handling the ownership within the legal element is one of the biggest challenges for universities. Ownership of the course, teaching resources and also students should also be indicated and agreed in the contract. The contract agreement should also clarify financial contribution for each university. In addition, the universities responsible for the management and maintenance of the Virtual Learning Environment (VLE) should be specified in the contract.
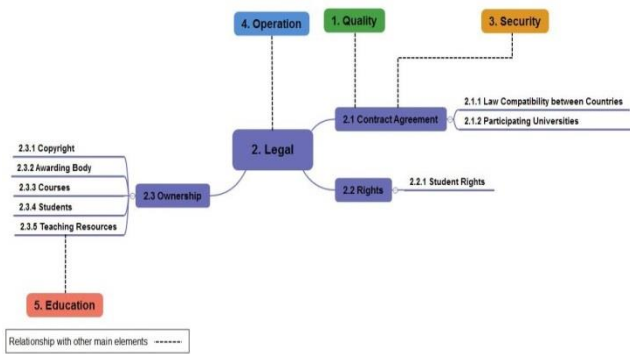
Figure 3. Legal Element

4.3 Security Element

Security relates to authentication, access to teaching resources, assessment materials and confidential and sensitive information, as shown in figure 4. With a shared environment, universities need to pay more attention to security in respect of access of students and staff. The authentication methods ensure that the student who is taking the assessment is the same person who is registered on the course. Therefore, the security mechanisms used should be agreed between the universities and reflected in the contract.
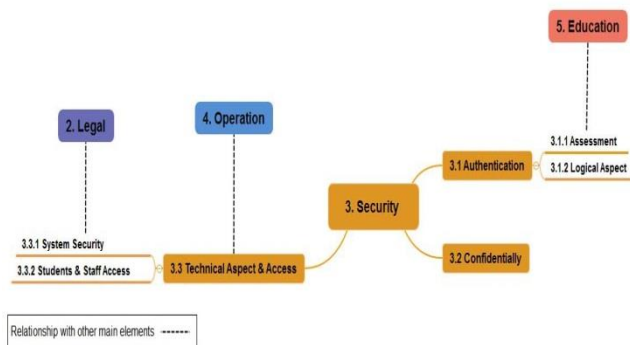

Figure 4. Security Element

4.4 Operation Element

There are a number of operational issues associated with course development, student enrolment, delivery, staff development, course management, finance, marketing, and student support, as shown in figure 5. The course development and delivery are joint activities between universities which can lead to well designed courses, offering high quality learning to students. Staff training and development will influence the quality of delivery and student experience.
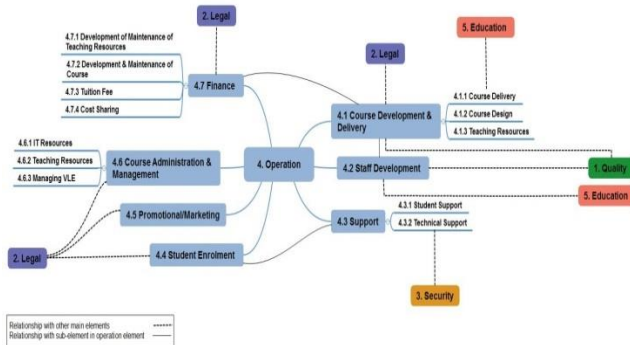

Figure 5. Operation Element

Sharing the cost will make the development and delivery of the courses more financially viable. Therefore, the collaborative cost model is normally included in the agreement. The process for enrolment should be clear, and the tuition fee and the process for its increase need to be discussed and agreed.

The consortium should agree which university will be responsible for course administration and management. Also, which university will be responsible for managing the VLE. These should be included in the contract.

4.5 Education Element

Education broadly relates to teaching, learning, assessment and the collaborative environment which supports it, as shown in figure 6. Ownership of the teaching materials needs to be specified and agreed.
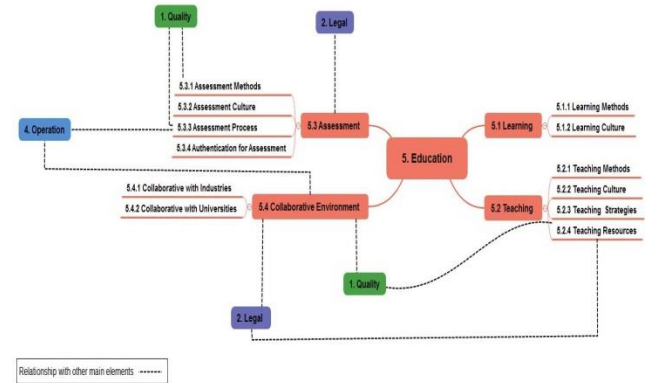

Figure 6. Education Element

The quality assurance process for assessment also needs to be agreed. The assessment system or platform which will be used between universities should be identified and agreed. Quality of teaching resources is another important issue which should be considered for the collaborative environment.

5. THE PROTOTYPE

Due to the complexity and size of the framework, a prototype has been developed to test part of it. The prototype is to illustrate some of its concepts prior to establishing a collaborative environment for online course provision. The prototype is designed to help university partners to check compliance with the process and avoid detrimental effects. The focus of the prototype is on course development and assessment processes.

The prototype illustrates some of the guidance which should be available to the partners. It shows the steps and processes which should be taken into consideration in the collaborative environment. For the purpose of this paper, only the course development process is illustrated and discussed.

Two types of users are considered for the prototype, which is admin and normal users. Normal users can select the course code from the course list and view the list of the universities that are in collaboration for it. In addition, the system allows normal users to access documents that have been approved collaboratively and view details for each stage.

Moreover, the prototype allows admin users to edit the status for the process of each university involved with the course in the collaborative group. The system sends notifications to each member who has been involved in collaboration for a specific course.

In terms of course development, it is expected that universities will conduct market research at the initial stage. Thus, universities need to explore first if there is demand for a course before moving to the development stage. The processes also involve identifying the lead university and also agreeing on the cost model. A quality assurance process needs to be agreed. Therefore, the representatives from each university need to be identified to lead on this. The flowchart in figure 7 shows the processes.
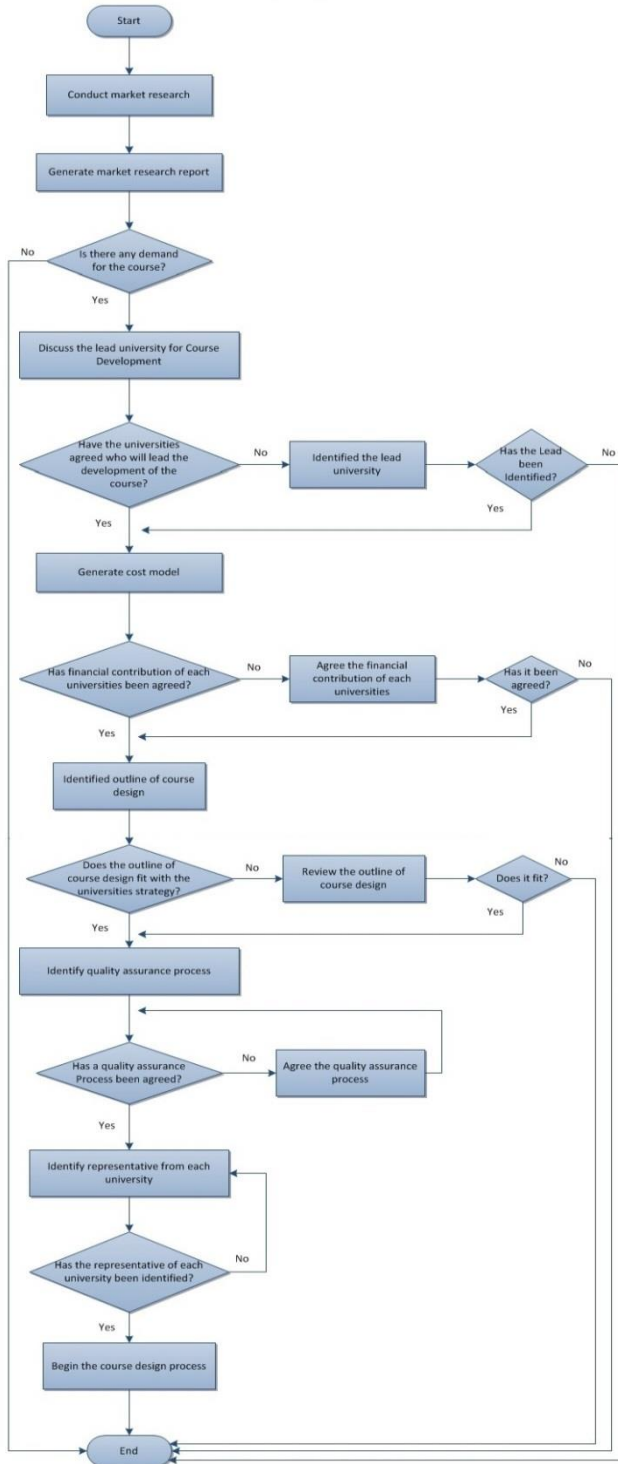

Figure 7. Flowchart for course development process

As illustrated in figure 8, when a user logs onto the prototype and selects a specific collaborative course, for example, Master of Software Engineering (MSc-SE) the system will display the list of universities involved in the collaboration. Figure 8 also shows the status in respect of course development, the assessment and the development of assessment materials for each university.
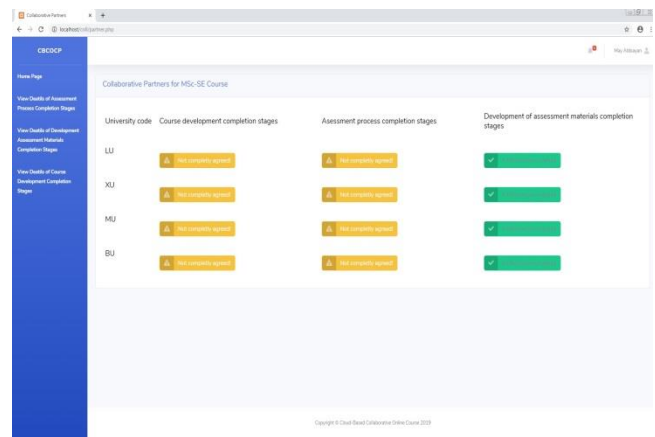

Figure 8. Collaborative partner for Master of Software Engineering course

In figure 8, the yellow colour indicates that the whole or part of the course development allocated to the universities is not completed yet. The green colour indicates that the development of assessment materials designated to those universities for MSc-SE course has been completed.

When a user wishes to see the details and the status for course development, he/she needs to select the yellow button, as shown in figure 9. Thus, in this example, the prototype illustrates the course development steps for MSc-SE and the status for the specific university selected.
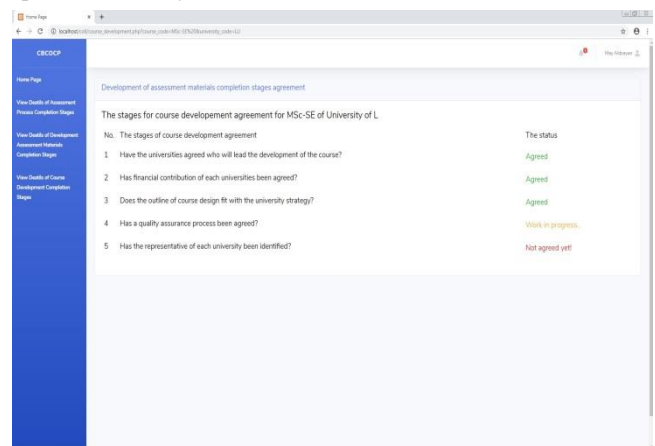

Figure 9. Course development process for specific university

To view the details for the course development process, a normal user can select (view details of course development completion stages) from the navigation bar. Also, the user can use the link provided on that page to download the agreed documentation for further information and guidance.

6. CONCLUSION

Universities involved in collaborative work for online course provision may face many issues and challenges. A conceptual framework is being proposed for a collaborative environment between universities. The framework includes five elements

which are quality, legal, security, operation and education. The framework also illustrates the relationship between each element. The paper also discussed a prototype which is designed to illustrate how the framework can aid universities in this collaborative environment.

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