A Conceptual Framework for Cloud-based Collaborative Online Course Provision

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ABSTRACT

The number of online courses offered worldwide by higher education institutions has been growing rapidly. There are a number of challenges and issues that may affect online course delivery and student learning such as the experience of academic staff and students with online courses, design of course structure, creation of suitable teaching resources, and the study culture.

Collaboration between universities for the design and delivery of online courses can have many benefits. They include enriched educational culture, fostering of a collaborative environment, resource sharing, cost reduction, and enhanced quality of courses.

Cloud computing can support collaborative environments due to its flexibility, scalability, reliability, availability and mobility, resulting in reduced IT costs. It can provide easy access to resources for both students and university staff.

A mixed methods research approach was adopted to collect the views of academics and students with respect to cloud-based collaborative online course provision. Semi-structured interviews were conducted with academics from different universities to explore the issues associated with the cloud-based collaborative online course environment. Two questionnaires collected the views of both academics and students in greater depth from a wider perspective. A number of challenges and issues were identified for consideration and incorporation into a cloud-based framework for a collaborative environment. Such issues related to security, confidentiality, ownership, contract agreement, quality assurance, finance, culture and course development. These issues and others were grouped together into five elements, which are quality, legal, security, operation and education.

A novel conceptual framework for a cloud-based collaborative environment was developed, which is based on five main elements, illustrating the relationship between them. A prototype was developed to test parts of the framework to illustrate some of its concepts and its utilisation in a collaborative environment. The framework and the prototype were evaluated by practitioners. The analysis of the views illustrated the appropriateness of the framework structure, grouping of the elements, relationship between the elements and the issues associated with each element.

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulation of Bournemouth University. The work contained in this thesis is the result of my own investigations and has not been accepted nor concurrently submitted in candidature for any other award.

I declare that while registered as a candidate for the research degree, I have not been a registered candidate or enrolled student for another award of the university other academic or professional institution.

LIST OF PUBLICATIONS

Conference papers

Aldoayan, M., Sahandi, R., John, D. and Cetinkaya, D., 2019, Collaborative Cloud-based Online Courses: Issues and Challenges. In *Proceedings of the 2019 8th International Conference on Educational and Information Technology*. Cambridge 2-4 March 2019, 17-21.

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LIST OF ABBREVIATION

API	Application Programming Interface
AWS	Amazon Web Services
CMA	Competition and Markets Authority
C-VLE	Cloud-based Virtual Learning Environments
CPU	Central Processing Unit
EC2	Elastic Cloud Service
ESaaS	Education Software as a Service
e-LMS	e-Learning Management System
Frog VLE	Frog Virtual Learning Environment
GDPR	General Data Protection Regulations
GLUE!	Group Learning Uniform Environments
HEIs	Higher Education Institutions
ICT	Information and Communication Technologies
IT	Information Technology
IP	Intellectual Property
IQR	Interquartile Range
IaaS	Infrastructure as a Service
LMS	Learning Management System
MoE	Ministry of Education
MOOCs	Massive Open Online Courses
NIST	National Institute of Standard Technology
OWA	Office Web Apps
PaaS	Platform as a Service
PC	Personal Computer
PHP	PHP Hypertext Preprocessor
QA	Quality Assurance
SDLC	Software Development Lifecycle
S3	Simple Storage Service
SaaS	Software as a Service
TCB	Trusted Computing Base
VLE	Virtual Learning Environment
VLEs	Virtual Learning Environments

VMs	Virtual Machines
XAMP	Cross-Platform Apache, MySQL, Perl
WWW	World Wide Web

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CHAPTER 1: INTRODUCTION

Online courses offered by Higher Education Institutions (HEIs) are becoming increasingly popular as a means of distance education across the world (Oncu and Cakir 2011). They provide students with interactive learning experiences without requiring them to be in the same room, or even in the same country (Pisutova 2016). The number of online courses offered by universities is increasing due to student demand (Oncu and Cakir 2011). Each year, the number of distance education students is growing rapidly in the United Kingdom (HESA 2020). Overseas students enrolled in distance learning programs in the UK universities since 2017/18 were about 24,585, but this grew to 28,395 in 2018-19 (HESA 2020). Also, since the end of the 20th century, online courses have grown and become established in European countries and North America (Lenar et al. 2013). The number of students enrolled in online courses is increasing yearly due to the many benefits that they offer, such as flexibility, access to materials anywhere and at any time, cost savings, and collaborative learning (Al-Arimi 2014; Panigrahi et al. 2018).

Despite their benefits, there are many issues that may affect the delivery of online courses, particularly with regards to their design and the quality of the learning experience. One issue is that it takes considerable effort to convert existing courses to online versions because the teaching methods are different from the ones used in face-to-face teaching. The role of tutors in online courses changes from directly transferring knowledge to that of a guide to conduct students through the learning process (Kyei-Blankson and Keengwe 2013). Some academics find changing their teaching style from face-to-face to online delivery challenging. Producing teaching resources for online delivery can be challenging too (Kebritchi et al. 2017). Lecturers may not have experience of designing resources for online courses, due to a lack of relevant training courses (Kyei-Blankson and Keengwe 2011). Additionally, the development costs and those of keeping online teaching resources up-to-date are significantly higher than for courses delivered on campus (Hanover Research 2014).

In addition, students' preferred learning styles might be influenced by their cultural background. They may find it difficult to move to an online style of learning because they are used to face-to-face teaching and learning methods (Pisutova 2016), or they might need to develop the learning skills required to join online courses, such as time management, self-motivation, self-efficacy and self-directed learning, which they may

find challenging (Kebritchi et al. 2017). A further issue is that online courses use collaborative learning activities to help students develop deeper understanding. However, students often do not feel comfortable adapting to this approach due to expectations derived from their own culture of face-to-face courses with which they are more familiar (Damary et al. 2017). Students may not feel comfortable with joining groups for teamwork and communicating with peers (Damary et al. 2017), and they may face problems with the language used in the course (Pisutova 2016).

One way to address these issues would be to adopt a cloud-based collaborative environment between universities. Such an environment would provide many benefits to universities, academics, and students, amongst them the sharing of expertise and cost efficiency. Collaborative environments provide opportunities for universities to develop courses and teaching resources jointly (Styliano and Savva 2017), and they encourage lecturers to adapt their teaching methods after sharing experiences with other academic staff. In addition, they can help universities to reduce staff training. Collaborative learning environments can also increase student knowledge through the sharing of information on online student forums (Damary et al. 2017). They can help students to develop critical thinking by using discussion boards and forums, and through group assignments and coursework help them to improve their teamwork skills (Somaratne 2015; Pisutova 2016).

Cloud computing, with all the properties and benefits that entails, including accessibility, scalability and flexibility (Sultan 2010; González-Martínez et al. 2015), is a suitable technology for supporting such a collaborative environment. It provides opportunities to improve efficiency for the educational institutions (Sultan 2010) and enables users to access virtualized resources containing servers, storage, applications and networks (González-Martínez et al. 2015). Cloud computing provides access to online services anywhere and enhances the availability of online applications (González-Martínez et al. 2015), whilst delivering hardware and software as a service via the internet – software that will be updated automatically in the cloud (Bora and Ahmed 2013). Virtual laboratories can be improved using cloud computing, thereby renewing physical resources and reducing the complexity of management. Cloud-based virtual laboratories are also available 24/7 (Ristove et al. 2014), and this and all of the above benefits are attracting universities to migrate their IT infrastructures to the cloud (Sultan 2010). Cloud computing could be utilised to enhance and facilitate the collaborative environment between universities globally.

This research proposes a conceptual framework for cloud-based collaborative online courses provision. The framework includes the five main elements, quality, legal, security, operation, and education, and it illustrates the relationships between each of the elements. Each element was expanded to include sub-elements and their relationships to other elements. A prototype was designed to test part of the framework. The purpose of the prototype was to illustrate some of the concepts prior to establishing a collaborative environment for online course provision.

1.1 DEFINITIONS

This section provides concise definitions for the terms used within this thesis. Further definitions and explanations are provided in Chapters 2 and 3.

Online course refers to an online degree programme for undergraduates and postgraduates.

Short course refers to short online courses that enhance and develop learners' skills.

Module refers to one of the units that together make a complete course taught at university.

Topic refers to a subject that is discussed or studied.

1.2 RESEARCH AIM

To develop a conceptual framework for cloud-based collaborative online course provisions.

1.3 RESEARCH OBJECTIVES

1) To review the literature concerning online course provision, including that for collaborative online learning and teaching environments, and cloud computing in education.

2) To determine the issues associated with current online course provision,

3) To identify the main benefits of cloud-based collaborative environments,

4) To identify the main issues that universities should consider before establishing cloud-based collaborative online course provision,

5) To develop a conceptual framework for cloud-based collaborative online course provision and identify the key elements,

6) To illustrate the relationships between key elements and sub-elements in the framework,

7) To develop a prototype to test part of the framework and to illustrate some of its concepts prior to establishing a collaborative environment,

8) To evaluate the conceptual framework and prototype by academics, managers and administrators involved with online delivery of education using two questionnaires.

1.4 RESEARCH QUESTIONS

1) What are the limitations of the current approaches to online course provision that is managed by individual universities?

2) What are the main issues that universities should consider before commencing collaboration with other universities for the provision of cloud-based online courses?

3) What additional benefits do cloud-based collaborative environments provide for online course provision?

4) What are the key elements that a cloud-based collaborative framework for online course provision between universities should involve?

5) What are the relationships between key elements and sub-elements in the framework?

1.5 METHODOLOGY OVERVIEW

The nature of this research is exploratory, and it was conducted in six main phases:

1) Literature review: the survey of existing literature explores the issues in current online courses, determines the benefits of collaborative learning and teaching and investigates the characteristics of cloud computing in education,

2) Mixed methods phase 1: semi-structured interviews conducted with academic staff in various roles from different universities and offering online courses. They were undertaken to explore the challenges and issues involved with collaborative online course provision,

3) Mixed methods phase 2: the findings from phase 1 were supplemented by those from two survey questionnaires given to academic staff and students. They were conducted in order to generalise the interview findings and to investigate further issues,

4) The development of a conceptual framework to facilitate cloud-based collaboration for online course provision between universities,

5) The development of a prototype to test part of the framework,

6) Evaluation of the conceptual framework and prototype by analysing the views of a group of academics who had experience with online courses.

1.6 CONTRIBUTION TO KNOWLEDGE

1) An exploration of the issues associated with cloud-based collaborative environments for online course provision,

2) A proposed novel conceptual framework that considers challenges and issues and illustrates the relationships between them. The framework is unique in considering the issues prior to adopting a collaborative environment between universities,

3) Development of a prototype to demonstrate the use and functionality of part of the framework for a cloud-based collaborative environment,

4) A methodology for analysing the evaluation of both framework and prototype,

1.7 THESIS STRUCTURE

The remainder of this thesis consists of eight chapters which are described below:

Chapter 2: Online courses

Chapter 2 presents a review of the relevant literature, focusing on online course provision and related issues. In addition, the chapter concentrates on the collaborative environment for learning and teaching and for collaboration between universities and industry.

Chapter 3: Cloud computing

Chapter 3 presents a review of cloud computing technology in terms of characteristics, deployment models, model services and architecture, and also discusses its benefits, issues and challenges. It presents cloud computing in education and cloud-based VLE, and in addition, discusses related work.

Chapter 4: Research methodology

Chapter 4 presents the research methodology used in this study, including the mixed methods adopted to answer the research questions. It explains all research methods employed, from qualitative interviews and quantitative questionnaires to analytical methods. It also presents brief details concerning the development of the framework and the prototype. Ethical considerations and limitations of the study are also presented.

Chapter 5: Findings from the interviews and questionnaires

Chapter 5 presents the findings of the mixed methods research. Firstly, semi-structured interviews explored the issues associated with cloud-based collaboration for online course provision. Secondly, surveys generalised the issues that were identified in the interviews and investigated new issues.

Chapter 6: Conceptual framework

Chapter 6 discusses the framework for cloud-based collaboration for online course provision based on exploratory research studies and literature review. The framework includes five main elements and illustrates the relationship between the elements, and the sub-elements.

Chapter 7: The prototype

Chapter 7 discusses the prototype, which is designed to test part of the framework. The prototype illustrates some of the framework concepts prior to establishing a collaborative environment for online course provision.

Chapter 8: Evaluation of the conceptual framework and prototype

Chapter 8 discusses the evaluation of the framework and prototype. The evaluations were based upon the views of experts from various countries on the use and development of online course***s***

Chapter 9: Conclusions and future work

Chapter 9 presents a summary of the research and its contribution to knowledge. The chapter also makes suggestions for future work.

1.8 SUMMARY

This chapter provides an introduction to the context and domain of this thesis and introduces the aim, objectives and research questions. It also sets out the methodology overview, contribution to knowledge and thesis structure. The next chapter will present a review of online courses and collaborative environments.

CHAPTER 2: ONLINE COURSES

This chapter provides an overview of the subject of online courses which helped to identify the existing problems and research gaps. It presents the history of these courses and their benefits to students and universities and also describes the technology that is used for their delivery and to support student activities. It defines collaboration in the context of this thesis and presents the benefits of online collaborative learning and teaching environments.

2.1 THE HISTORY OF ONLINE COURSES

Technology has a relationship with distance education as it mediates between instructors and learners via the use of print, radio, television, audio, videotapes and computers. This relationship illustrates the increased importance of using technology in distance education (Sumner 2000). The first generation took the form of a correspondence course which was well established by the end of the 19th century. Correspondence courses involved the use of print-based course materials and postal services (Sumner 2000). Distance education courses were offered by the end of the 19th century in European, American and Canadian universities (Sumner 2000).

The second generation of distance education courses combined the use of print with cassettes and broadcast media. With technological development came the opportunity for communicative action through two-way contact. The main aim of the second generation was to deliver teaching materials of various kinds to learners. Interaction with students, however, was limited, and interaction between them non-existent (Nipper 1989 cited in Sumner 2000). The old multimedia course form of the Open University included the one-way technologies of radio, television, video cassettes and audio.

The third generation was computer-mediated and based upon the technologies that ushered in the information era, including the Internet and the World Wide Web (Sumner 2000). Where coursework, quizzes, CD-ROMs and linked websites may have added to the information available to learners, but without offering the necessary communication with other learners (Sumner 2000). Computer conferencing supports interactivity and had the potential to help students to collaboratively construct knowledge (Garrison 1997).

Distance education was born, and nowadays online courses have reached an advanced stage of development and are expanding due to the Higher Educational Institutions (HEIs) which now provide courses internationally (Nakayama et al. 2014). The benefits of online courses are discussed in Section 2.2.

2.2 ONLINE COURSES

Online course delivery has grown rapidly due to advances in Information Technology (Dumford and Miller 2018), and Information and Communication Technologies (ICT) play an important role in the delivery of learning content by universities worldwide (Park 2011). The number of students taking these courses has increased rapidly due to the benefits they offer, including reduced costs and remote access from the country of residence (Al-Arimi 2014; Panigrahi et al. 2018). Online courses provide easy access to online materials from anywhere (Murphy and Stewart 2017; Arkorful and Abaidoo 2015). They also provide learners with the flexibility to access course materials at a convenient time to help balance their family and work responsibilities (Sun and Chen 2016). The delivery of online learning materials can be supported by a variety of media, including slides, video and animation, that students can access via a virtual learning environment (Lu and Chiou 2010).

Online courses save time for learners and help them towards a better learning experience through participation in online discussion boards with peers from different countries, cultures and backgrounds (Al-Arimi 2014). They offer students opportunities for thinking and responding in online discussion forums, without the pressure to make an immediate response as is the case in face-to-face classroom discussion groups. Learners in the shared forum can built understanding and involve and collaborate in discussion with peers while sharing joint resources such as reading, video and links (Brady et al. 2010). Yet, face-to-face education can also provide online discussion forums as extra support. In addition, they offer students opportunities to interact more actively with their lecturers via email or forums since they cannot meet their lecturers face-to-face as they might on a campus-based course (Kim et al. 2005). Furthermore, there are usually digital recording facilities of the communications between students and lecturers that provide students with an opportunity to review previous explanations, comments and posts (Brady et al. 2010). Online courses support students in obtaining a qualification through easy access to

modules, materials and videos, via an appropriate technology, without the need to travel to a campus to attend lectures (Arkorful and Abaidoo 2015).

Courses of this kind are a convenient way to encourage and enable people with disabilities to participate (Nurmukhametov et al. 2014). They allow those with learning disabilities, to review materials as many times as they need, compared to face-to-face delivery. Students with dyslexia or visual processing disorder can manipulate digital text by swapping their font style or size through using software that assist them in processing the information effectively. They also allow those with physical disabilities to remain in the comfort of their home without the need to attend sessions on campus. Those with hearing impairments can view their lecturer's videos with subtitles, which they cannot experience in face-to-face courses (Barden 2017).

Universities offering online courses are not required to use physical spaces such as buildings, lecture rooms or physical laboratories, thus running an online course is cost-effective compared to an on-campus equivalent. A recorded video lecture can be used by a number of classes and can be uploaded by many students at the same time or at different times, compared to traditional lectured face-to-face courses (de Oliveira et al. 2018; Al-Arimi 2014; Panigrahi et al. 2018).

2.2.1 MASSIVE OPEN ONLINE COURSES (MOOCS)

Massive Open Online Courses (MOOCs) "*are a mechanism of mass dissemination of information through an internet-based educational course to potentially very large and internationally distributed groups of learners*" (Maxwell et al. 2018, p.736). MOOCs enable learners to join in through a variety of learning methods, and the media involved consist of videos, live chat, and online assessment (Maxwell et al. 2018). MOOCs are an online provision allowing learners to register for short courses without paying enrolment fees (Hew and Cheung 2014; Hoy 2014). They are very popular and constitute the modern development of open educational resources. An unlimited number of learners have access to the available MOOC courses (Al-Rahmi et al. 2019), and the number of academic publications delivered via MOOCs has increased rapidly (Yousef et al. 2014).

MOOCs provide a number of larger universal platforms (Coursera, edX, FutureLearn). Coursera (Coursera 2020) was launched in 2012 and became the biggest MOOC provider in the world. The number of students enrolled is over 37 million in 2019. Coursera

consists of more than a hundred and sixty universities and more than twenty industry partners. The platform also delivers fully online master's courses in some fields such as public health, business, and computer science (Shah and Pickard 2019). On the other hand, edX is the second largest MOOC provider worldwide and was founded by Harvard University and MIT in 2012. It has more than 18 million learners and its 139 university partners provide approximately 2,200 courses. edX also has an online degree program, FutureLearn, was launched by the Open University in the UK in 2013. FutureLearn is the UK's MOOC platform and has attracted more than seven million learners from across the world since its launch. It offers 15 degree courses, including one bachelor's degree (Shah and Pickard 2019).

MOOCs consist mostly of short video lectures joined together with computer-graded quizzes and online discussion boards that enable learners to share information and access help, and they represent incredible educational resources available online to anyone who has time to learn (Hoy 2014). They enable learners to selectively obtain knowledge without the need to enrol at a specific university or to pay tuition fees (Maxwell et al. 2018), and also to concentrate on specific topics to increase their knowledge or to learn a new topic that will help them in their career (Hew and Cheung 2014; Barnes 2013). Learners often prefer this kind of short online course for collecting certificates and improving the skills required for their work (Hew and Cheung 2014). These courses offer learners the opportunity to exchange views and ideas with each other during online forums and meetings. Therefore, learners prefer to spend a lot of time in the discussion forum to acquire a knowledge of and learn from each other (Rao et al. 2015).

MOOCs are categorised into two main kinds, 'cMOOCs' and 'xMOOCs'. cMOOCs supply space for self-arranged learning where learners can clarify their own objectives, offer their viewpoints and collaboratively build and share expertise. cMOOCs allow learners to create their own networks through Google, blogs, Wikis, Facebook and other social networks. xMOOCS such as Coursera and edX adhere to constructivist, behaviourist and cognitivist learning theories (Yousef et al. 2014). They enable instructors to present their knowledge using short video lectures that are usually supported by simple e-assessment tasks to measure progress against pre-defined learning objectives (Yousef et al. 2014).

2.3 USE OF TECHNOLOGY WITH ONLINE COURSES

The rapid advancement of technology is changing the way information is transmitted by HEIs and developing the approach to delivering courses (Dealing 1997 cited in Nicholson 1998). The computerized delivery mechanism for distance learning has been used for the higher education agenda since the 1970s (Nicholson 1998). The fast development of the WWW played an essential role in supporting online course delivery by using the Virtual Learning Environment (Brown 2010).

A VLE is a software environment for managing online intercommunications of different kinds that take place among instructors, learners and the learning components; the participation of students in such interactions constitutes online learning. The use of VLEs in universities has become an essential strategy for quality education. VLEs are used to improve both face-to-face courses and online course delivery (Park 2011), and their functionality has improved to involve a wide range of university information processing systems, to establish a controlled learning environment, and to assist personal learning (Brown 2010).

VLEs provide a number of features to instructors and students, making it easy to use the system, the delivery of online materials flexible, and integrating a set of tools and activities to help learners (Brown 2010). The integration of external tools in VLE aims to enhance the learning activities that specialist practitioners in education may design and implement (Alario-Hoyos et al. 2013). Such Group Learning Uniform Environments (GLUE!) facilitates the performance of collaborative activities in VLEs, leveraging their characteristics for the management of groups and users (Alario-Hoyos et al. 2013). VLEs are integrated with online assessment systems and video streaming services (Heaton-Shrestha et al. 2007).

VLEs are also called Learning Management Systems (LMS) (Dillenbourg et al. 2002). Blackboard, Moodle and LAMS (Blackboard 2020; Moodle 2020; LAMS Foundation 2020) are familiar examples of VLEs that differ somewhat from the preferences of instructors and HEI's (Alario-Hoyos et al. 2013). They provide a variety of services and functions for the delivery of online courses (Park 2011). VLEs enable learners to access learning materials, assessment and guidance. They also enable instructors to track learners' activities and achievements. VLEs connect to other systems, inhouse and externally (Heaton-Shrestha et al. 2007).

Communication tools (discussion boards) available within the VLE can be used with each module/unit (Heaton-Shrestha et al. 2007), and asynchronous discussion boards make it possible for learners to obtain support anywhere and at any time (Park 2011). Instructors can create groups for students working on a project and students can have private discussion boards which enable them to share files (Heaton-Shrestha et al. 2007). In addition, instructors are able to create quizzes and tests for formative or summative purposes (Heaton-Shrestha et al. 2007). Additional features are useful for supporting and improving interactive learning in the VLE, such as the ability to grade, make announcements and conduct surveys (Park 2011).

2.4 ISSUES ASSOCIATED WITH ONLINE COURSES

The key issues associated with online courses can be summarised as: the learning and teaching culture, students' experience and expectations, academics' experience in online course delivery, creating teaching materials for a module, and financial aspects. The review of the literature revealed a number of important issues associated with online courses which are discussed below.

- **The learning and teaching culture:** A student's learning style might be affected by their cultural background (Pisutova 2016). For example, international students who come from a culture with a teacher-centred (face-to-face) learning environment tend to regard the teacher as the source of all knowledge and information. Some may be used to face-to-face learning environments, but this does not apply to all online students (Damary et al. 2017). Students may also find it difficult to move to an online style of learning because they are familiar with their own learning methods (Pisutova 2016).

  International students may find that the assessment styles used in online courses are different from those in their home countries (Liu et al. 2010), while others may submit their assignments late and not appreciate the significance of assignment deadlines (Kyei-Blankson and Keengwe 2013).

  Collaborative online learning is also subject to other issues related to culture. Some international students, for example, find it more difficult than others to share their understanding with other students during team working and collaborative activities (Damary et al. 2017). In addition, some prefer to work as a team, whereas others prefer

to work individually, something that is largely dependent on their culture (Liu et al. 2010).

Lecturers will have their own teaching methods informed by their culture and may find it difficult to adapt to online teaching styles (Pisutova 2016), thus those who come from teacher-centred backgrounds may not have the experience and skill to teach online courses effectively (Haugen et al. 2001). Lecturers' roles in online courses are very different from their roles in face-to-face courses, which can make it difficult for international students to understand that role (Damary et al. 2017).

- **Issues related to students:** Students need to be self-directed, self-motivated and to have good time management skills to participate in online courses, and this can be challenging for them (Kebritchi et al. 2017). They can encounter problems with the international language used in the online course (Pisutova 2016), and may have to use translations, especially when they want to interact with peers and express their opinion in discussions (Al-Arimi 2014; Kim et al. 2005). They may also encounter issues with plagiarism, and especially with paraphrasing and acknowledging sources (Kirsch and Bradley 2012).

  Students can be reluctant to collaborate online with their peers if the universities do not provide the necessary support (Osipov and Ziyatdinova 2015), and as a result, may not realise that the collaborative activities are part of the learning process. They may not feel comfortable moving from a traditional classroom to online teaching which may include shared activities for learning (Damary et al. 2017). There is a requirement for more global cases in online course content; for example, online courses delivered from the United States typically focus on United States cases and situations and may not provide a global perspective (Liu et al. 2010). Users may not understand the content or context when applying concepts related to another part of the world to situations in their own country (Liu et al. 2010).

  Learners might also experience difficulties interacting online and communicating with their lecturer and other students in real-time discussions because they are in different time zones. Those in another part of the world to the students and teaching staff they should be interacting with may not be able to join in with real-time online discussions or conferences (Liu et al. 2010).

Issues related to academics: Changing the nature and environment of course delivery from face-to-face to online can be challenging for some lecturers. The method of delivery for online courses is different from traditional face-to-face as the role of the lecturer changes from a static transferor of knowledge to that of a subject expert who guides students through the learning process. Some lecturers find a variety of teaching methods that are used in online courses challenging and may feel uncomfortable with them (Kebritchi et al. 2017; Kyei-Blankson and Keengwe 2013). Also, the design and preparation of online course materials may take more time than for face-to-face courses (Kyei-Blankson and Keengwe 2013).

- **Issues related to creating teaching materials for a module:** Typically, it is the lecturer who is responsible for designing and preparing the teaching materials for online courses (Kyei-Blankson and Keengwe 2013). However, producing new teaching materials and moving from traditional face-to-face delivery to online courses can be challenging (Kebritchi et al. 2017). Some lecturers are reluctant to change their teaching approaches and methods to make them more suitable for online courses (Kyei-Blankson and Keengwe 2013). There has been a shortage of training courses to support lecturers as they move from a face-to-face teaching style to an online teaching method, and they often cannot use the same materials for online courses (Kebritchi et al. 2017). In addition, it is time-consuming for lecturers to design materials for an online course using new technology (Kebritchi et al. 2017; Kyei-Blankson and Keengwe 2013).

  Other issues related to module design include the application of multimedia such as video, audio and games, for if used in the wrong way, they can have a negative effect on the learning process. To ensure a good impact and make the learning content appealing to students, there are certain rules and principles that lecturers should follow when designing module contents that use multimedia (Majumdar 2016; Kebritchi et al. 2017). Some academic staff, however, do not have the skills to use technology effectively and require training (Al-Arimi 2014).

- **Issues related to finance:** The overall cost for an online course can include the costs of development, delivery, and administration. The development costs for online courses are significantly higher than for face-to-face courses and include expenditure on the production of materials, staff, and equipment (Hanover Research 2014). In

addition, reluctance by universities to pay for lecturers to be trained in designing and delivering online courses has led to a lack of training programs (Hanover Research 2014; Sjogren and Fay 2002).

2.5 COLLABORATION IN EDUCATION

The definition adopted in this research states that "*Collaboration is defined as a joint working, learning and sharing process that specifically focuses on teaching activities, learning and researching amongst educational participants, in which knowledge can be activated and transferred*" (Pham and Tanner 2015, p.3). Most instructors agree that collaboration includes bringing groups and people together for a shared goal (Goulet et al. 2003).

Collaboration is an aspect of the educational context that consists of three elements: consultation, collegiality and cooperation. Consultation usually includes discussion, looking for or giving information, or sharing of expertise which is an essential part of the collaboration (Goulet et al. 2003). Collegiality, another essential element of collaboration, indicates that there is an equal and friendly relationship between colleagues in which everyone's knowledge and expertise is valued. According to (Terosky and Heasley 2015) collegiality is faculty members' capability to belong to a community of colleagues who value their participation to the institution. It highlights chances for faculty members to learn and get knowledge from one another by having a sense of belonging and inclusion (Terosky and Heasley 2015). Joint working is a part of this, where instructors undertake team teaching, planning, and research, and it indicates a kind of mass commitment on the part of those who are working together. Collegiality nurtures connective knowledge and the transformative relationship with peers when the relationship between participants is reciprocal. Cooperation, the third part of the collaboration, is the element that requires effort to understand another participant's knowledge in order to achieve a joint goal (Goulet et al. 2003).

Collaborative partners find themselves consuming much time building and keeping relationships. In a collaborative project, the university experts often begin a relationship to develop, modify and understand academic practice. The participants also attempt to acknowledge 'each other's diverse expertise. Each partner contributes to the sharing environment in differing ways and degrees, although all are committed to the development of practice and understanding and improvement of theory (Goulet et al.

2003). Each partner values and respects other ideas and strengths in order to attain a shared goal. In collaboration, it is essential to value each contribution and allow each member of the group to have a feeling of belonging (Goulet et al. 2003).

Collaboration in this research is concerned with the cloud-based version between universities that provides online courses, as discussed in Chapters 5 and 6. The following section (2.5.1) considers collaborative learning between students that aims to enrich their understanding. The benefits of collaboration between academics are presented in Section 2.5.2, and collaboration among universities and industries is dealt with in Section 2.5.3.

2.5.1 COLLABORATIVE LEARNING

Collaborative learning can be defined as "*an educational approach to teaching and learning that involves groups of learners working together to solve the problem, complete a task, or create a product*" (Laal and Laal 2012). Online collaborative learning refers to "*educational applications that emphasise collaborative discourse and knowledge building mediated by the Internet; learners work together online to identify and advance issues of understanding, and to apply their new understanding and analytical terms and tools to solving problems, constructing plans or developing explanations for phenomena*" (Harasim 2012, p.88). Online collaborative learning can enhance and improve learning by engaging students and instructors to confirm a positive experience in an online course (Chandrasekaran et al. 2016). It provides students with opportunities to become knowledge builders (Harasim 2012).

Damary et al. (2017) mention that online collaborative learning leads to students sharing knowledge, which enables them to develop a deeper understanding of the learning materials. In addition, it helps students to encourage each other to learn by sharing explanations of what they understand from their lecturers. Collaborative learning can assist students to develop and practice social skills such as communication and decision making (Laal et al. 2014), and it can help learners to develop critical thinking and negotiation skills through the use of online discussion boards and forums (Somaratne 2015). Additionally, it encourages students to improve their teamwork skills (Pisutova 2016; Somaratne 2015). Collaborative learning in an online course leads to improved learning outcomes between students and helps to establish learning communities as they share their understanding of specific topics (Laal et al. 2013; Higley 2018). Students who

work within collaborative teams appear to acquire more information and knowledge than those who work individually, as they exchange information with each other (Laal et al. 2013).

There are many tools that can enhance collaborative learning in online courses, for example, Wikis, forums, Google Docs, Google Apps, and Dropbox (Al-Samarraie and Saeed 2018; Biasutti 2017).

Learning tools that support collaboration

Forums are collaborative learning tools which can be implemented in VLEs such as Blackboard and Moodle. Online discussion forums are asynchronous online communication tools which require no real-time interaction between students (Hou and Wu 2011). Forums allow students to express their views and share their ideas at a time that suits them and in any location (Biasutti 2017). Online discussion forums help students to improve their learning performance (Hou and Wu 2011).

Google Docs is an online document that enables students to share documents and access them at any time and from any place. It allows online students to edit the documents and instructors to add feedback on student assignments (Blau and Caspi 2009).

Wiki is an online learning tool that enables students, lecturers, classes and universities around the world to collaborate. Its discussion pages enable students to engage in debates and to communicate with each other, facilitating the sharing of knowledge. Students are able to create new wikis to add information and join existing ones to use the information and resources already available (Zheng et al. 2015). Wikis allow students to post comments and create documents to share with other peers (Augar et al. 2004), so are useful tools for group projects because they allow students to meet virtually and work on a project collaboratively (Parker and Chao 2007). Dropbox is another cloud tool that learners can use to share their files, which can be accessed from anywhere (González-Martínez et al. 2015).

The benefits of online collaborative learning tools are better accessibility, flexibility and availability (Carter et al. 2018).

2.5.2 COLLABORATIVE TEACHING

Collaborative teaching allows lecturers to share responsibility with their peers in teaching related activities such as curriculum design, content development, presenting teaching materials and assessing students' work (McNair et al. 2016). In universities that aim to improve instructors' performance and research capabilities, there is growing recognition of the need for collaboration between instructors and other professional support staff. Such sharing might involve choosing an appropriate educational resource and embedding research skills into the curriculum (Pham and Tanner 2015).

Collaborative teaching is one of the most beneficial, but also one of the most challenging, experiences for lecturers in universities (Orzolek 2018). A collaborative environment can support the faculty as it designs new programs of study (Stylianou and Savva 2017), helping faculty members to share workloads and decisions when collaboratively developing a new course (Ziegenfuss and Lawler 2008). In addition, collaborative course development provides benefits of merging the experience of experts and instructional designers (Xu and Morris 2007). This environment can be set up within one university but there is also the potential to establish sharing between multiple universities (Stylianou and Savva 2017).

Collaboration between academics can encourage individuals to work together to achieve a shared goal through the sharing of knowledge and ideas (Bevins and Price 2014). It is also an excellent approach to exchange experience with academics together. Collaborative teaching can also help academics to improve their teaching methods, for example, when they are working together on assigned task and sharing materials (Doppenberg et al. 2012). It promotes the organisation of teaching materials and improvement of their quality (Pham and Tanner 2015). Collaboration between academics can also enhance teamwork skills (Bevins and Price 2014), and when carried out successfully, it will increase their confidence and encourage the building of positive relationships with peers (Keefe et al. 2004).

Newell and Bain (2020) reported that collaborative course design between academics in HEIs is important because it improves learning, teaching and course quality. It is also a way to bring together combined expertise and intelligence to build a shared vision and commitment to quality courses. Collaboration is a necessary approach to addressing the issues that currently influence the quality of outcomes (Newell and Bain 2020).

2.5.3 COLLABORATION BETWEEN UNIVERSITIES AND INDUSTRY

Collaboration between universities and industry refers to interaction between any parts of the higher education system and industry that is essentially aimed at promoting knowledge and technology exchange (Ankrah and Al-Tabbaa 2015). It is an essential strategic instrument for improving the efficiency and effectiveness of industrial investment in research and development (Fernandes et al. 2019). As a result of global competition, industrialised economics in Western countries relies massively on producing knowledge and conducting research and development to maintain economic prosperity. Policy makers want academic researchers to contribute further to applied research, technological improvement, and to the dissemination of technology (Hillerbrand and Werker 2019).

Collaboration between universities and industry has been growing in a number of countries, including those of the European Union, the United States, Japan, and Singapore. Increasingly seen as a way to improve innovation through knowledge exchange (Ankrah and Al-Tabbaa 2015), this growth has been attributed to a mixture of pressures on both parties. In industry, the pressures have involved rapid technological change, shorter product life cycles and strong global competition that have fundamentally transformed the competitive environment for most firms (Ankrah and Al-Tabbaa 2015). For universities, pressures have included a rapid increase in new knowledge, the challenge of increasing costs and funding issues, and the need to seek relationships with firms to allow them to stay at the leading edge in all subjects. The pressures on both universities and industry have stimulated an increasing desire for collaborative development that aims to promote innovation and financial competitiveness at institutional levels together with knowledge exchange among academic and economic domains (Ankrah and Al-Tabbaa 2015).

The motivations for collaboration between university and industries are reciprocity, efficiency, and stability. With regard to reciprocity, universities provide wide access to a broad set of research infrastructure and research expertise, whereas industries provide wide access to a broad range of expertise in product improvement, market knowledge and employment chances for university graduates. Consequently, universities are motivated to establish relationships with industry for mutual benefit (Ankrah and Al-Tabbaa 2015). In terms of efficiency, rising pressure on public sources of finance has provided strong

motivation for universities to explore alternative sources of income for primary research and equipment. Examples include the licensing of patents and commercialisation of faculty research to minimise their dependence on public funding (Ankrah and Al-Tabbaa 2015). With regard to stability, collaborations between universities and industry that expose students and staff to the industrial environment, instructional case studies, and practical issues addressed by projects, have all contributed to curriculum improvement and helped to develop the quality of teaching (Ankrah and Al-Tabbaa 2015).

2.6 SUMMARY

This chapter has presented a brief description of the history of online courses, beginning with distance education. It discusses the features that online courses provide for learners, such as easy access to materials, flexibility, and facilitation of online discussion through forums, and looked at the technology used to facilitate the delivery of courses online. The chapter also considered issues related to learning and teaching cultures, students, academics, the creation of teaching materials for modules, and finance, and concludes with a description of the benefits of collaborative learning and teaching and the collaboration between universities and industry. The next chapter will discuss cloud computing technology.

CHAPTER 3: CLOUD COMPUTING

This chapter discusses the technological application used in this research to facilitate the collaborative environment for online courses. It discusses the definition of cloud computing and its characteristics, cloud deployment, and service models. It highlights the features of cloud computing as well as its usage in HEIs.

3.1 CLOUD COMPUTING

Cloud computing is an evolution of both computer technology and the dominant business model for delivering IT-based solutions (Iyer and Henderson 2010). In the 1950s, the first generation of Information and Communication Technology began with a mainframe computer. The mainframe was a huge centralized computing platform (Ebbers et al. 2016). Figure 3-1 shows the computing paradigm shift of the last half-century and identified six phases. In phase 1, the user was connected to the mainframe in 1960, which was shared by many users using terminals. Phase 2 of the computing paradigm shift was the evolution of personal computers in 1970, which enabled the user to conduct their daily work without the need to share a mainframe with anyone else. In phase 3, computer networks in 1980 allowed multiple personal computers to connect via local networks, and in phase 4, local networks appeared that connected to others which created a global network in 1990. Thus, users were able to access the Internet to use distant applications and resources. With the arrival of phase 5, the electronic grid facilitated the sharing of computing power and storage resources in 2000. In phase 6, the evolution of cloud computing enables users to use all the available resources on the Internet in 2007 (Voas and Zhang 2009).

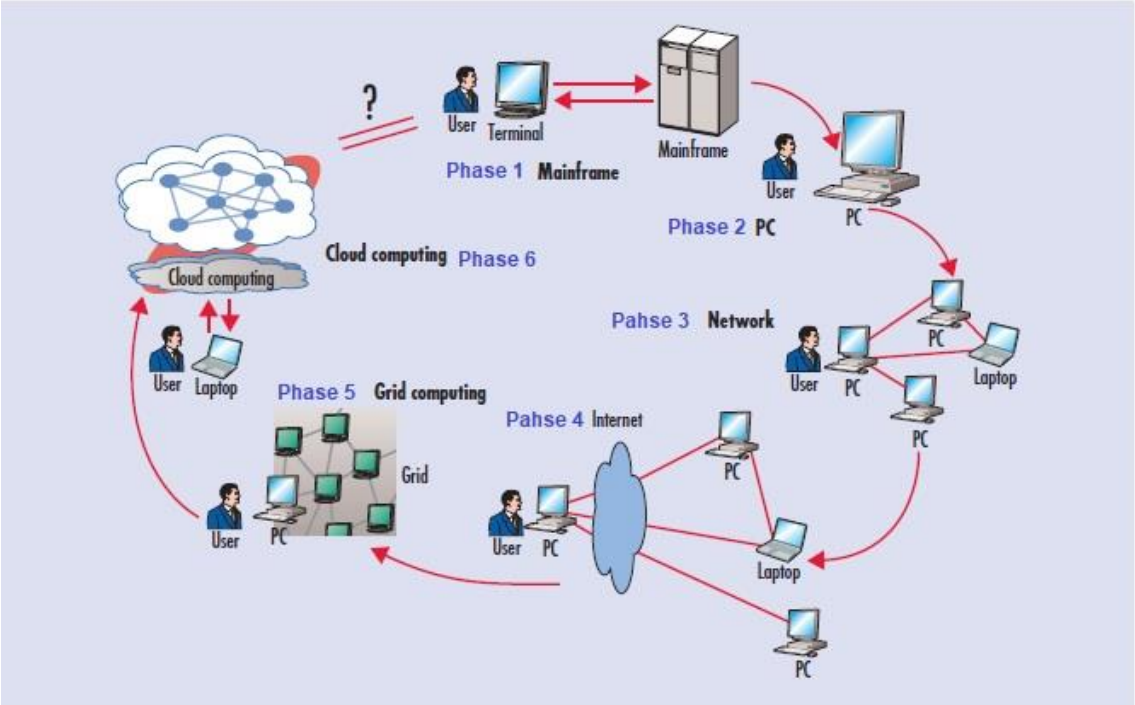


Figure 3-1: Computing paradigm shift, over six phases adapted from Voas and Zhang (2009)

When compared to the infinitely powerful Internet cloud, PCs appear similar to lightweight terminals, which enable users to utilise the cloud. However, there are a number of significant differences between the two. Mainframe computing provides limited computing power, whereas cloud computing offers almost unlimited capacity and power. Furthermore, in mainframe computing, the terminals represent user interface devices, whereas, in cloud computing, personal computers can provide local cashing support and computing power (Voas and Zhang 2009).

The main aim of cloud computing is the better use of distributed resources via the Internet (Jadeja and Modi 2012). It is a model for delivering IT resources and services, and is defined by the National Institute of Standard Technology (NIST) as follows:

> "*Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g. networks, server, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction*" (Buyya et al. 2013, p.8).

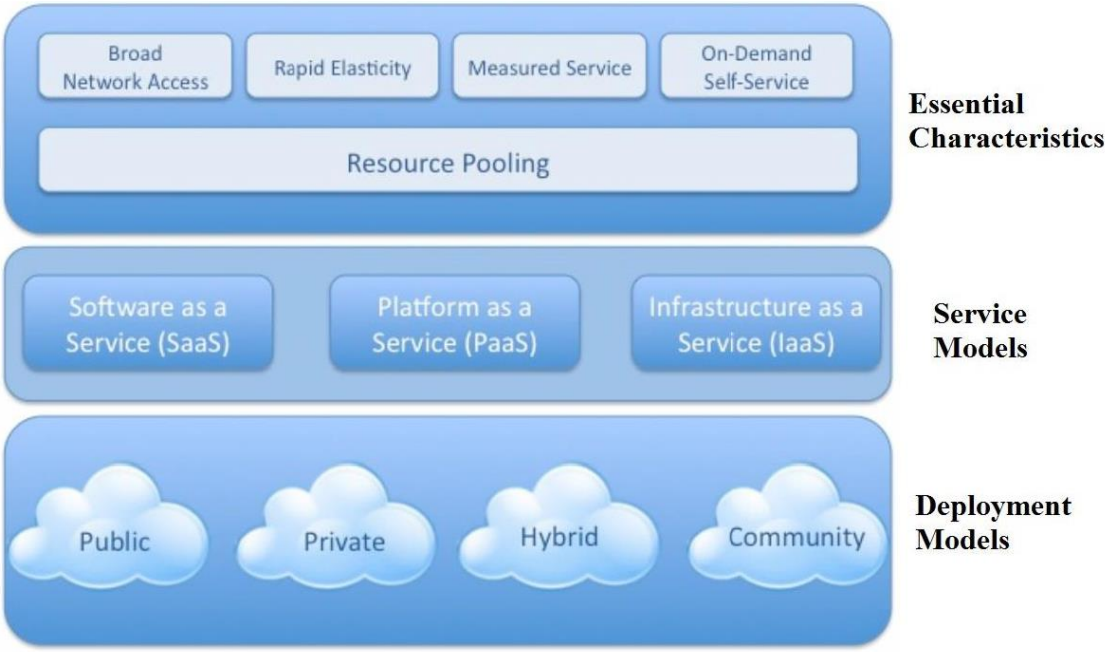


Figure 3-2: Cloud computing models (Mell and Grance 2011)

As shown in Figure 3-2, cloud computing consists of five main characteristic cloud services, three service models and four deployment models which appear as layers in cloud technology. These will be discussed in the following sections.

3.1.1 CLOUD COMPUTING CHARACTERISTICS

Based on the NIST definition of cloud computing, the five vital characteristics are identified as:

- **Broad network access:** or the resources of computing delivered through the Internet (Dillon and Chang 2010). Such access enables the client to access services through different devices such as desktops, laptops, tablets and mobile devices (Mahmod 2011).

- **Rapidly elasticity:** which enables the organisation to scale up or scale down service requirements according to the clients' needs (Mahmod 2011).

- **Measured service:** this enables the organisation to control all resource usage and create possible limits or expand resources when needed by using pay-per-use (Mahmod 2011).

- **On-demand self-service:** organisations can request cloud services such as server time, network storage and applications from the cloud provider. The organisation can request to expand services as needed (Mahmod 2011).

- **Resource pooling:** this enables multiple users to share computing resources in a specific cloud deployment model (Mahmod 2011).

3.1.2 CLOUD COMPUTING SERVICE MODELS

Cloud computing providers have three main service models, which are Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS) (Sultan 2010).

- **Software as a Service (SaaS)**:

  A software layer provides applications that run online using cloud infrastructure and enables users to access those applications from different devices at any time (Sultan 2010; Mell and Grance 2011). The service providers are responsible for installing and upgrading the applications, thus there is no need to install the application on a user's computer (Akande and Belle 2014). The end-user has no right to change the application apart from customising it using the choices available in the software (Gajbhiye et al. 2014). Furthermore, users are shifting from a locally installed application on their computer to an online software service (Voorsluys et al. 2011).

  The cloud providers have full control and manage the cloud infrastructure, which means that users or consumers have no need to do so (Mell and Grance 2011). With the SaaS model, organisations to reduce the cost of software installation, updates, maintenance and software licencing (Gajbhiye and Shrivastva 2014). SaaS provides the further advantage of scalability, as organisations can scale their services based on user demand.

- **Platform as a Service (PaaS)**:

  PaaS is a cloud computing service which is offered remotely by cloud providers to their clients (Sultan 2010; Mell and Grance 2011). This model provides a computing platform such as a server, operating system, storage, programming language, and database (Akande and Belle 2014; Sultan 2010). PaaS providers provide hardware

and software tools for users which enable them to run, deploy and develop their applications (Mell and Grance 2011; Akande and Belle 2014). They offer services for maintaining, designing, and debugging the complete application throughout its development lifecycle on the Internet (Hudaib et al. 2014).

PaaS providers have control over and manage the cloud infrastructure, including operating system, server, storage, and network, whereas users cannot manage these things but can control the deployed application and configuration settings (Mell and Grance 2011). PaaS is useful for developing particular applications that need powerful computing resources at low cost (Hudaib et al. 2014).

- **Infrastructure as a Service (IaaS)**:

IaaS delivers infrastructure resources to organisations on-demand through the Internet, such as those for computation, communication and storage (Sultan 2010). It allows users to scale and shrink computing resources as needed, which leads to a reduction in expenditure for those HEIs using the cloud (Akande and Belle 2014; Sultan 2010). The organisations can pay per use for the computing resources used (Marston et al. 2011). The resources in this model will be used as virtualised resources (Voorsluys et al. 2011). The users are not able to manage the cloud infrastructure, but they have control through storage, deployed application and probably restricted control over choice networking components (Mell and Grance 2011).

3.1.3 CLOUD COMPUTING DEPLOYMENT MODELS

Cloud computing has four deployment models: private cloud, public cloud, community cloud, and hybrid cloud (Mell and Grance 2011).

- **Public cloud**

Public clouds enable the general public to use cloud infrastructure, which is available via the Internet. The public cloud is owned by a third party organisation that provides cloud services (Mell and Grance 2011). Cloud providers can manage infrastructure and pool resources (Goyal 2014). Public clouds can be used by diverse clients, from organisations to individual users (Marston et al. 2011; Leloglu et al. 2013), and are located on or off the premises of the cloud provider (Mell and Grance 2011). The clients who use the services need to pay for the duration of their usage, which helps

the organisation to reduce IT expenditure and the costs of the operation. Popular cloud providers that offer their services to the general public include Google, Amazon, and Microsoft (Voorsluys et al. 2011).

Users of public clouds have no need to purchase hardware to use the service and can scale their use on-demand (Goyal 2014), whilst their data and technical expertise are available 24/7. Public clouds can be used to support third-world countries that lack powerful IT resources and enable them to offer better IT services (Goyal 2014). They are, however, less secure than other deployment models, and the data they host is therefore prone to attack (Jadeja and Modi 2012).

- **Private cloud**

  The private cloud model enables a single organisation to operate the cloud infrastructure that can be owned and managed by the same organisation or a third party. The private cloud exists on or off the premises of the cloud provider (Leloglu et al. 2013). The main benefit of the private cloud is that it maximises the use of existing in-house resources. It is easy to manage security, to upgrade, and to maintain it. The organisation manages the application and resources by itself (Jadeja and Modi 2012). In a private cloud, the computing resources are made accessible to users at the organisational level (Jadeja and Modi 2012). Security, including data privacy and trust, is enhanced, as only users from the organisation can access the private cloud (Dillon and Chang 2010; Jadeja and Modi 2012).

- **Hybrid cloud**

  A hybrid cloud is a combination of two or more cloud deployment models (private, public or community) (Mell and Grance 2011). A private cloud in this model is connected to one or more external cloud services. Hybrid clouds are more complicated than the other kinds of cloud deployment models (Goyal 2014), and are very secure for use with data and applications. They enable the third party to connect to information via the Internet. Organisations can serve their needs in the private cloud and can request intensive computing resources from the public cloud (Jadeja and Modi 2012).

Hybrid clouds offer scalability and cost-effectiveness benefits from the public cloud, but also provide security from the private cloud. They support the optimization of infrastructure expenditure during various stages of the implementation of the lifecycle (Goyal 2014). Hybrid clouds can develop resource distribution for temporary projects at an immensely reduced cost as the utilization of public clouds removes the demand for investment to perform these projects (Goyal 2014).

- **Community cloud**

  It is a cloud infrastructure where computing resources are shared between a number of organisations (Mell and Grance 2011). It supports a particular community which has shared interests and concerns such as policy, mission and security requirements (Savu 2011). Community clouds are located between public and private clouds with regard to their target clients (Goyal 2014). They can be owned and managed by one or more organisations or a third party, and are located on or outside the premises of the cloud provider (Mell and Grance 2011).

3.2 RELATED TECHNOLOGIES AND CONCEPTS

Cloud computing is not a stand-alone phenomenon in Information and Communication Technology. Several technologies need to be identified and explained to enhance our understanding of cloud computing. These include grid computing, utility computing, clustering, and virtualisation.

- **Grid computing**

  Grid computing is "*a type of parallel and distributed system that enables the sharing, selection, and aggregation of geographically distributed 'autonomous' resources dynamically at runtime depending on their availability, capability, performance, cost, and users' quality-of-service requirements*" (Buyya et al. 2009, p.601). It is a distributed infrastructure of software and hardware that supplies arranged resources sharing to attain a high level computational goal, for example, running an engineering application (Buyya et al. 2009).

  Grid computing uses middleware as one of the vital strategies to categorise and distribute pieces of the program between multiple computers. It varies in size from a small computer workstation network within a company to largescale cooperation

between companies and networks (Sadashiv and Kumar 2011), and is a weaker form of cloud computing, as there is virtualisation that associated with (Biswas 2011).

- **Utility computing**

  Utility computing includes the renting of resources on demand, such as software, network bandwidth and hardware. In utility computing, clients are charged depending on their usage of computing resources rather than at a fixed rate. Utility computing and grid computing may be considered as applications of cloud computing. Thus, cloud computing can implement everything in grid computing and utility computing and much more (Biswas 2011).

- **Clustering**

  A cluster is "*a collection of parallel or distributed computers which are interconnected among themselves using high-speed networks*" (Sadashiv and Kumar 2011, p.477). The group of IT resources work together in the execution of data-intensive and compute-intensive tasks which would not be possible with a single computer. Cluster computing is used primarily where there is a need for guaranteed availability, reliability and load-balancing. In cluster computing, the rates of system failure are reduced, whereas the availability of the system and reliability are increased, thus they sustain unnecessary nodes that are used to supply service when the system fails. The system performance in clustering is developed such that if one node fails another node will take over (Sadashiv and Kumar 2011). In the cluster system, multiple computers are connected to each other as a single virtual computer to share the computational workload, thus improving performance (Sadashiv and Kumar 2011).

- **Virtualisation**

  Virtualisation enables abstraction and isolation between lower-level functionalities of a computing platform and end users (Vouk 2008). It is the establishment of a virtual version of a server, storage, operating system and network resources (Sajid and Raza 2013). It allows the portability of functions at a higher level whilst sharing physical resources. The concept of virtualisation has been around since the 1960s, since when it has grown remarkably and been applied to all resources of computing including software, memory, storage, IT services and processors (Vouk 2008).

Visualisation is one of the main technologies that make it possible to understand and realise cloud computing. It allows clients to move their computation and data to a distant location with varying effects on performance. It offers a number of benefits, such as scalability, cost-effectiveness, elasticity, customisation, and infrastructure independence (Sajid and Raza 2013).

3.3 CLOUD COMPUTING ARCHITECTURE

Cloud computing architecture includes four layers: hardware, infrastructure, platform and application (Zhang et al. 2010). The bottom layer is the hardware layer which is responsible for controlling the physical computing resources of the cloud, including servers, switches, and CPU power (Zhang et al. 2010), as shown in Figure 3-3.

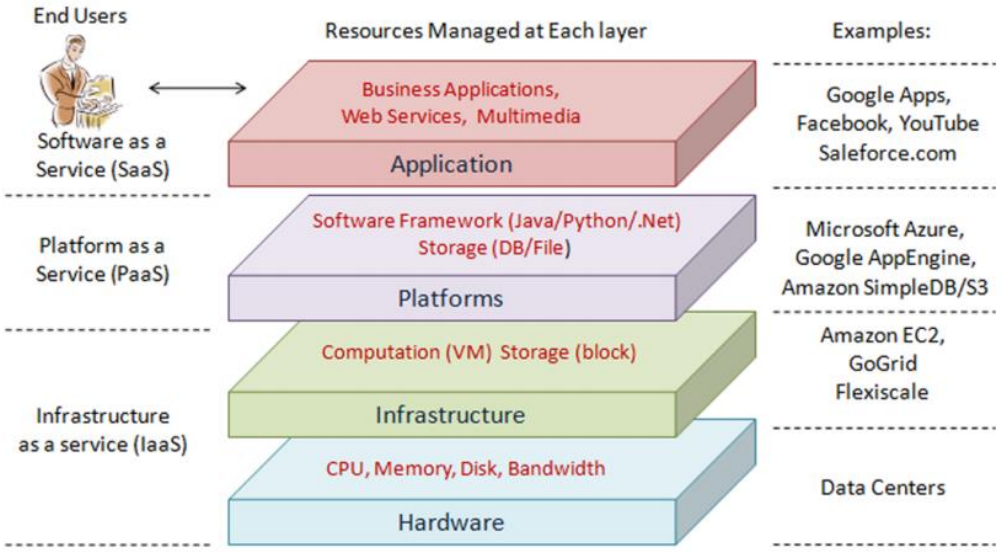


Figure 3-3: Cloud computing architecture (Zhang et al. 2010, p.9)

The hardware layer is located in a data centre which houses thousands of servers that are arranged in racks and connected via switches and routers. This is an underlying layer for the above logical layers and offers a number of cloud features. The primary purpose of this layer is to ensure a constant high capacity (Zhang et al. 2010).

The infrastructure layer is also referred to as a virtualisation layer because it establishes a pool of computing resources and storage by dividing the resources in the hardware layer using virtualisation technology such as VMware. The infrastructure layer is a fundamental element of cloud computing, as many key features, such as scalability and elasticity, are only achieved via virtualisation technologies (Zhang et al. 2010).

The platform layer is built on top of the infrastructure layer and it includes a software framework and operating system. The aim of the platform layer is to reduce the load of deploying applications immediately into a virtual machine box. Such a Google App Engine exist at the platform layer to support the Application Programming Interface (API) which provides databases and storage (Zhang et al. 2010).

The highest level of cloud computing architecture is the application layer which hosts the cloud applications. The cloud applications support the scaling features that ensure availability, better performance and reduced operating costs (Zhang et al. 2010).

Each layer in cloud architecture is combined with the layers above and below, but each layer can be developed individually. Cloud architecture as a whole facilitates the support of a wide range of application requirements whilst reducing expenditure on maintenance and management (Zhang et al. 2010).

3.4 CLOUD COMPUTING BENEFITS

Cloud computing provides several features which can encourage an organisation to migrate their Information Technology (IT) resources and systems (Zhang et al. 2010). The significant benefits of cloud computing are:

- **Cost-saving:** cloud computing has a pricing model known as 'Pay-as-you-go', where clients pay for services as they use them. Therefore, there will be savings when the demand for services is low, resulting in lower operating costs (Zhang et al. 2010). There are cost savings related to hardware, as cloud computing offers virtualisation on demand, again via a pay per use model (González-Martínez et al. 2015). In this system, the cloud computing provider owns the resources, and the organisation pays per use. Moreover, there are cost savings with regard to software, as certain cloud tools can be provided for free, such as Google Docs, Dropbox, and YouTube (González-Martínez et al. 2015; Sultan 2010).

- **Flexibility**: cloud computing provides flexibility to users as they can access their files at home, or indeed anywhere. It also increases staff mobility by allowing them to access applications and information from anywhere (Sultan 2010; Craig et al. 2009).

- **Availability:** services and applications offered by the cloud are available online, 24/7 and everywhere (González-Martínez et al. 2015). Clients can use easily accessible

cloud services via a variety of devices – desktop, laptop, tablet, mobile phone – over the Internet (Zhang et al. 2010).

- **Scalability:** cloud computing makes it easier for an organisation that depends on accurate information to scale up or scale down their service requirements according to their clients' needs (Marston et al. 2011). It offers a high-quality service to a huge number of users (González-Martínez et al. 2015).

- **Collaboration and sharing:** cloud file storage enables different stakeholders to share, store, and retrieve data via email and shared web links (Gupta et al. 2013). Google Apps, for example, facilitates the sharing of content and files with other stakeholders (Sultan 2011). In addition, it allows a team to access those files anywhere and edit them in real-time.

- **Ease of implementation:** organisations that deploy cloud computing do not need to purchase software licenses, hardware or implementation services (Craig et al. 2009).

- **Mobility:** cloud computing enables mobile access to data through smartphones and devices. It also gives staff with busy schedules, or who are away from the office, the opportunity to keep up-to-date with colleague and clients (Gagliardi and Muscella 2010).

- **Reducing business risks and maintenance expenses:** service providers can reduce hardware maintenance costs and staff training expenditure. Thus, the service provider in cloud computing moves the business risks to the infrastructure provider who is better equipped and has the expertise to manage the risks (Zhang et al. 2010).

- **Reliability**: cloud computing involves many virtual servers operating on a physical server; thus it provides more consistency to the IT infrastructure (Cunsolo et al. 2010).

- **Multi-tenancy:** since cloud infrastructure is used by several users (Kaaniche and Laurent 2017), multi-tenancy is a way of attaining an economic return by employing virtualisation to share computer resources (AlJahdali et al. 2014).

- **Back up capacity:** cloud computing offers organisations virtually unlimited storage capacity. Users can now store massive amounts of data in the cloud at a lower cost

and can schedule regular backups with a guarantee that it will be available when needed (Gajbhiye and Shrivastva 2014).

- **Enabling delivery of new services, application models:** cloud computing supports organisations by enabling them to offer new services which were not possible prior to the adoption of the cloud due to the higher costs of IT solutions (Marston et al. 2011). These include services and applications associated with the Internet of things, mobile technology and big data (Botta et al. 2016).

3.5 CLOUD COMPUTING SERVICE PROVIDERS

A cloud service provider is a third-party organisation providing a cloud-based platform, infrastructure, software or storage services (Microsft Azure 2020). Cloud computing providers that offer flexible services the user through the Internet and established new data centre to host applications such as Amazon, Microsoft, Google, and IBM (Al-Zoube et al. 2010).

- **Amazon Web Service (AWS):** that offer cloud infrastructure, which is one of the most secure and flexible cloud computing environments (Le Roux and Evans 2011). AWS offers four types of product: computes, database, networking and storage (Tajadod 2012). AWS offers remarkably scalable, a highly reliable platform which allows users to deploy software and data securely and quickly (Varia and Mathew 2014). One of the best cloud computing platform services are the Elastic Cloud Service (EC2) and Simple Storage Service (S3) (Le Roux and Evans 2011). EC2 offers an environment for managing the virtual server on request and the operating system of the host system. S3 is a distributed data storage on the Internet (Tajadod 2012).

- **Microsoft Azure Platform:** is the key component of the Microsoft cloud provider. It offers a programming model to establish scalable and available application (Tajadod 2012). Windows Azure is the operating system for the datacentre which offers compute, management service and storage. The platform contains four vital components: Windows Azure Environment, Marketplace, AppFabric. Microsoft Virtual Machine is more scalable than Amazon EC2, while Amazon EC2 is cheaper than Windows Azure (Tajadod 2012).

- **Microsoft office 365**: is a combination with the platform of Microsoft Windows Azure to assure high productivity with cost-effective, saving money, time and free up worthy resources (Skendzic and Kovacic 2012). Microsoft Office 365 contains a large package of services that includes many products such as SharePoint Online, Exchange Online, and Lync Online for collaboration and communication (Skendzic and Kovacic 2012). Users can be accessed and edit via the Internet Microsoft Office Web Apps (OWA) such as a spreadsheet, word processing, excel, access database and OneNote that is hosted on the cloud (Al-Zoube et al. 2010; Skendzic and Kovacic 2012).

- **Google Apps:** is a service from Google and a set of web-based applications and file storage which work in a web browser, without needing users to buy or install the software (Skendzic and Kovacic 2012; Lakshminarayanan 2013). They enable users to log in to the service to reach their files and the tools to manage them. The tools of Google Apps are Google Docs that include spreadsheets, presentation, and text files. Google talk is one of the Google Apps tools, Gmail, Google calendar, Google sites to improve web pages (Lakshminarayanan 2013).

3.6 CLOUD COMPUTING ISSUES AND CHALLENGES

Cloud computing presents some challenges and issues which may affect its adoption, as follows:

- **Security**: the multi-tenancy model and the sharing of computer resources between users raises security issues for cloud computing. Hackers prefer to use cloud computing as the cloud offers more reliable infrastructure services with lower costs for creating botnets to start attacks (Dillon and Chang 2010). Data in cloud computing may be subject to breaches where sensitive or confidential information is stolen, released or accessed by unauthorized users (Cloud Security Alliance 2016).

  There are some potential security issues which relate to the PaaS service model, where a cloud service provider can access and use anything which resides on its hosts. In addition, users that are tenants of the same host can attack each other, and third parties can attack the user. An example of a solution to some of these issues is the Trusted Computing Base (TCB), Encrypted objects and Proxy Certificate (Sandikkaya and

Harmanci 2012). Data privacy has also been raised as an issue for cloud computing (Phaphoom et al. 2015).

- **Technical issues:** integrating the existing IT infrastructure with cloud computing technology may be challenging for some organisations which have already invested in their own IT resources. Thus, for some organisations, the decision to migrate to cloud computing will require particular effort with regard to configuration management and confirming compatibility (Durao et al. 2014). There are additional technical issues associated with performance, which refers to the ability to deliver a particular job within the given time and can be affected by factors such as bandwidth and internal IT infrastructure (Phaphoom et al. 2015; Chung 2014).

- **Non-technical issues:** adoption of cloud technology by external providers may for many organisations lead to legal issues related to privacy and data protection (Ferrer et al. 2012). The challenges about legal and compliance requirement should be considered with any organisations planning to adopt cloud computing (Ferrer et al. 2012). Also, the adoption of cloud computing by an organisation may lead to either staff losses or to an increase in workload (Mohapatra and Lokhande 2014).

3.7 CLOUD COMPUTING IN EDUCATION

Cloud computing is the new technological boundary for teaching, learning, and research in higher education (James and Weber 2016). HEIs can gain many benefits from cloud computing, the main enabling technology of which is virtualisation. Virtualisation, scalability, and on-demand provision, joined with the pay-per-use model in cloud computing, are important factors in the optimisation of hardware cost-saving for HEIs (Olaloye et al. 2019). Universities that make use of cloud computing do not need to spend money purchasing software, hardware and servers to set up on-site data centres because they pay only for the services that they use (Vaidya et al. 2020). Cloud computing also decreases the IT infrastructure costs for an institution as it is managed by the cloud providers (Singh and Baheti 2017).

HEIs can benefit from the SaaS, PaaS and IaaS cloud services that a provider offers without the burden of infrastructure set up or maintenance (Karim and Rampersad 2017). Cloud computing provides HEIs with the opportunity to focus on teaching and research practices rather than having to spend time on complicated IT execution, complex IT

planning and programming systems (Başaran and Hama 2018). The cloud computing applications associated with higher education will form the basis of future IT infrastructure in education, assuring the improvement of the hardware and software environment (Almajalid 2017). HEIs will no longer need to maintain software as the cloud service providers will do that for them (Karim and Rampersad 2017).

Cloud computing provides services that are highly reliable as it serves as a data backup that can be used for disaster recovery (Vaidya et al. 2020). It also provides course content backup, reducing the risk of data loss in the case of a system crash. Different types of content can be stored in the cloud, including documents, audio, video and applications (Karim and Rampersad 2017).

Cloud computing offers tools and applications that allow lecturers and students to deploy computing resources on-demand for lectures and virtual labs, depending on learning needs. These applications provide universities with a flexible learning environment, reduce hardware and software costs, and support mobile learning (Olaloye et al. 2019). Cloud computing also enables multiple students to work together on the same document (Karim and Rampersad 2017).

The cloud computing infrastructure ensures that educational activities can be carried out efficiently and at high speed that enables students and lecturers to access services 24 hours a day (Karim and Rampersad 2017). It allows them to access resources and work collaboratively with institutions and to communicate and share ideas and resources with other students and lecturers from other institutions anywhere and anytime (Singh and Baheti 2017).

3.7.1 CLOUD-BASED VIRTUAL LEARNING ENVIRONMENT (VLE)

A Virtual Learning Environment is a web-based platform that can provide an environment for controlling course delivery and assessment for students (Shen and Shariff 2016). Cloud-based Virtual Learning Environments (C-VLE) are equipped with the ability to access, create, save, retrieve and share educational resources anytime from any device connected to the cloud (Hew and Kadir 2017). Based on the huge potential benefits of C-VLE, the Malaysian Ministry of Education (MoE) has launched the cloud-based Frog VLE to 10,000 schools across the country (Hew and Kadir 2017). The Cloud-based Frog VLE enables instructors to deliver lectures virtually, give online tests, mark students'

assignments and publish their marks. In addition, students can contribute to the online discussion forum, learning activities and quiz, and they are able to check their scores through the VLE whilst their parents can communicate with the school. Frog VLE is a user-friendly platform which allows instructors and students to explore resources for teaching and learning (such as video clips and animations), collected together within a safe environment (Hew and Kadir 2016).

Canvas is a popular open source VLE due to its reliability, usability, adaptability and ease of implementation, and it is currently used by universities in the UK such as King's College London, Oxford Brookes and the University of Birmingham (Ng et al. 2019). Canvas is designed to be used in the cloud, which means there is no need for hosting, data backup, or upgrades, nor is it harmed when the servers crash (Grossi et al. 2018).

Previous studies have focused on Web-based platforms such as Blackboard (Blackboard 2020) and Moodle (Moodle 2020), which use grid computing technology that provides unlimited storage space, scalable educational material resources, and other features which are available in cloud computing technology (Hew and Kadir 2016). This technology offers the flexibility to use computing resources on-demand (Ercan 2010). Cloud-based VLE enhances system functionality as well as achieving users' growing needs and increasing the benefits they gain from educational experiences (Hegazy et al. 2015).

3.7.2 VIRTUAL LABORATORIES

Nowadays, the use of virtual laboratories in HEIs is very popular. Using Virtual laboratories in classroom learning as one of the forms to implement information and communication technology at universities. They allow students to access remote resources anywhere and anytime, and bring many advantages to universities, such as flexibility and cost-efficiency (Yusuf and Widyaningsih 2020). In addition, they enable several students to access the same virtual equipment at the same time (Potkonjak et al. 2016). Kolloffel and de Jong (2013) state that students who used virtual laboratories obtained a better understanding than students who used traditional laboratories which also improved their practical skills (Kolloffel and de Jong 2013). Virtual laboratories can promote the accessibility of experimental setups and offer distance teaching that meets students' needs (De la Torre et al. 2013).

Furthermore, virtual laboratories are an efficient web-based resource and give students a rich learning experience. They provide opportunities for them to engage in independent learning, as well as to experience problem-solving. They also develop student motivation and help to realise the potential of distance learning by increasing accessibility, availability and flexibility (Estriegana et al. 2019).

A cloud-based virtual laboratory is being used to reduce the complexity of managing and renewing physical resources. Students can access the virtual laboratory anytime from anywhere to run their experiments, at a fraction of the cost of using physical resources. Cloud-based virtual laboratories can improve the performance of the operating system and enable students to work anytime, which leads to better-balanced utilisation of the laboratory (Ristov et al. 2014).

Xu and Huang (2014) presented a cloud-based virtual laboratory, which includes an experimental environment, using virtualisation technologies and Openflow switches. The platform enables students to manage virtual machines (VMs) remotely and perform experimental tasks. The cloud-based virtual laboratory platform provides an interactive Web GUI for managing the resources, and a site for sharing knowledge. Cloud computing that provides data packages related to virtual laboratories needs to store those packages centrally, where they are and easily accessible (Erdem et al. 2016).

3.8 EXAMPLE OF CLOUD-BASED COLLABORATIVE FOR E-LEARNING

E-learning has become an important trend in HEIs and is growing in popularity throughout the world. However, the number of instructors at many universities is increasing slowly. As a result, students in e-learning environments faced an instructional issue due to the lack of adequate support for the learning process (Liaoa et al. 2014). Liaoa et al. (2014) suggested that collaborative learning environments using cloud computing should be adopted to tackle this issue. In this way, students could access support from other students and instructors who were connected through a collaborative learning forum based in the cloud (Liaoa et al. 2014). The study increased the support for online course students at one particular university by fostering a collaborative environment between students through the use of cloud tools.

El Mhouti et al. (2016) proposed a platform for the development of a cloud-based virtual collaborative learning environment to address the challenges of optimising large-scale resource management. The aim of this study was to take advantage of cloud computing services in the design of the VLE which would enhance the management of learning materials and their dissemination. The proposed platform was to support collaborative learning between students at the same university by combining the advantages of VLE and cloud computing technology, as shown in Figure 3-4. On this platform, tutors interacted with students and groups to follow their progress and guide them (El Mhouti et al. 2016). The study illustrates the benefits of supporting collaborative learning between students with individual university.

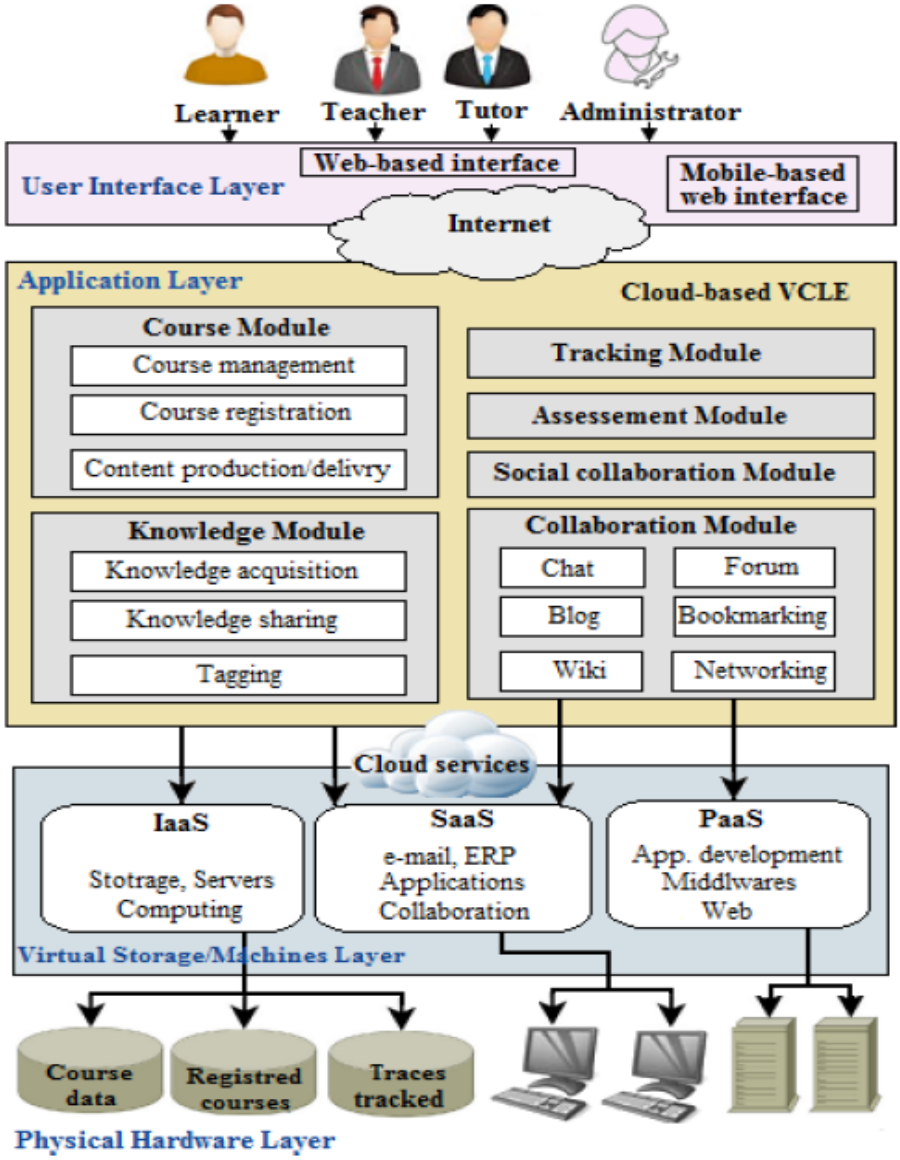


Figure 3-4: Architecture of a cloud-based Virtual Learning Environment (El Mhouti et al. 2016, p.5)

3.9 SUMMARY

This chapter discussed the evolution of the early generations of computing systems starting with mainframes and ending with cloud computing. It defines cloud computing, its characteristics, deployment models and service models, then moves on to introduce related technologies such as grid computing, utility computing, clustering and virtualisation. The chapter also discusses the benefits of cloud computing and the issues associated with adopting a cloud-based environment. The chapter presents a brief discussion about cloud computing service providers. It deals with cloud computing in education, cloud-based VLE and virtual laboratories, and details some example of cloud-based collaborative for e-learning that adopted in the individual universities. The next chapter discusses the methodology, which was adopted in this research.

CHAPTER 4: RESEARCH METHODOLOGY

This chapter describes how the methodology was implemented in this research to achieve its objectives. It explains the research philosophy, research methods, and research design and analysis techniques that were used.

4.1 RESEARCH PHILOSOPHY

A research philosophy is a set of beliefs that guide a researcher's choices as they collect and analyse data (Green 2008). According to Creswell et al. (2014), the research philosophy refers to a technique of beliefs and the development of knowledge assumption. Accordingly, there are four main research philosophies: postpositivism, constructivism, transformative and pragmatism.

- **Postpositivism:** also known as positivism, which is suitable for science-based research. The problems that are studied using postpositivism reflect the requirement to identify the causes that affect outcomes. Postpositivist assumptions are more suitable for quantitative than for qualitative research. In this approach, data is measured numerically and analysed statistically.

- **Constructivism:** Also known as Interpretivism, assumptions are suitable for qualitative research. The research assumptions tend to reflect the participants' views. Additionally, a human participant engages and makes sense based upon their social perspectives. Thus, Constructivist researchers set out to recognise the context by collecting information personally.

- **Transformative:** The philosophy concentrates on the needs of people who are powerless in society, and the researcher focuses on a particular issue – perhaps empowerment, suppression, oppression or alienation. Transformative research concentrates on inequalities based on disability, race, gender and ethnicity and associates social actions with political change. Transformative assumptions hold to a qualitative research focus on narrative design and interview.

- **Pragmatism:** The focus will be on research questions or a problem. All the available approaches are used to understand, address the questions involved to solve the problem. Pragmatism opens the door for researchers to use mixed-methods to investigate different views and assumptions to provide a good

understanding of the research problem. It enables them to use different forms of data gathering and analysis.

This research adopted a pragmatic philosophy, which required a mixed-methods approach to enable the researcher to understand the research problems. A range of approaches, both qualitative and quantitative were used to answer the questions and address the problem.

4.2 RESEARCH DESIGN

Research designs are the kinds of qualitative, quantitative and mixed methods approaches that offer a particular direction for procedures in a piece of research. They are also referred to as strategies of inquiry (Creswell 2014).

4.2.1 QUANTITATIVE DESIGNS

Quantitative design is a research approach that assures quantification in gathering and analysing the data (Bryman 2012). Quantitative approaches are associated with the postpositivist paradigm. The quantitative methods can be divided into two: survey and experimental research. The surveys offer numeric explanations of opinions, behaviour, attitude or trends of a population by studying a large sample. Experimental research seeks to determine whether an exact treatment affects a result (Creswell 2014). In general, quantitative methods are suitable for questions that need numeric results, while opinions and attitude are usually measured by quantitative methods (McCusker and Gunaydin 2014).

The main features of quantitative research are: 1) Researchers have a clear knowledge of what they are looking for, having defined their research questions and objectives; 2) They design each aspect of the study carefully before the data is collected; 3) They use tools, such as questionnaires and equipment, to gather numerical data; 4) Quantitative data can be used efficiently, which enables researchers to test hypotheses; 5) Data collected using quantitative methods are described in terms of numbers and statistics and arranged in tables or charts; 6) Quantitative methods can be adopted to generalise ideas broadly or to encourage further investigation of the topic (McCusker and Gunaydin 2014).

There are, however, some drawbacks associated with implementing quantitative methods. A result may lack contextual detail (McCusker and Gunaydin 2014), or may offer limited information about attitude, motivation and behaviour, thus the answers may not effectively reflect how participants feel about the issues. Therefore, a quantitative result

provides numerical explanations but offers a little description of human views (Berg 2004).

4.2.2 QUALITATIVE DESIGNS

Qualitative designs are used for exploratory research which sets out to discover new ideas or to obtain an understanding of issues, motivation or opinion about a research problem (Berg 2004; Heigham and Croker 2009). In qualitative designs, the approaches are drawn from sociology, the humanities and anthropology, and include narrative research, phenomenological research, grounded theory and case studies. Qualitative research can be used to investigate a problem in order to develop a hypothesis to be tested using quantitative methods. Qualitative methods use in-depth studies of a small group of participants to lead and help in the construction of hypotheses. The result of qualitative research is descriptive (Berg 2004).

The main benefits of qualitative research are: 1) Researchers gather data themselves by interviewing participants or observing attitudes or behaviour; 2) They are able to collect multiple forms of data, for example, observations and interview results, rather than having to depend on a single data source. 3) Qualitative methods provide researchers with opportunities to collect a wide range of data. 4) Researchers are able to clarify the difficult picture of the problem under study by using qualitative approaches (Kahlke 2014).

There are, however, some drawbacks associated with the qualitative design, such as researcher bias that can affect the data collection and analysis. In addition, the qualitative researcher needs to be experienced, and may also face problems to do with small sample size, which can require them to conduct multiple sessions in order to collect the necessary data. Furthermore, the data gathered by qualitative methods can be difficult to verify (Berg 2004).

4.2.3 MIXED METHODS DESIGNS

With mixed methods, the researcher adopts a multi-method matrix for data collection. They can combine qualitative data from interview, observation, and so on with quantitative data from surveys. Qualitative data consists of open-ended responses, whereas quantitative data consists of closed-ended responses, such as those required by questionnaires for example. There are many mixed methods designs, including convergent parallel mixed methods, explanatory sequential mixed methods, and

exploratory sequential mixed and transformative mixed methods. Convergent parallel mixed methods can be used if the researcher seeks to combine quantitative with qualitative data in order to perform an overall analysis of the research problem. Explanatory sequential mixed methods can be used if the researcher starts by conducting quantitative research, analyses the results, and then, based on the findings, conducts qualitative research. Exploratory sequential mixed methods should start by gathering qualitative data in an exploratory investigation and follow this up by gathering quantitative data from a large sample to generalise the result. Generally, sequential mixed methods are adopted when the researcher seeks to expand on the finding of one method using another. Transformative mixed methods offer an alternative framework for gathering data and results. The data in this design can be merged or can be ordered sequentially (Schoonenboom and Johnson 2017).

Mixed methods research has several benefits. Mixed methods provide opportunities for researchers to expand their understanding of the research problem. They increase the validity and reliability of the data. Another benefit of mixed methods is that they can be used to generalise the findings obtained from qualitative research. In addition, the researcher can use mixed methods to clarify unexpected findings and possible conflict.

However, there are some disadvantages associated with mixed methods research, one of which is that the design is complex. The methods and their design are time and resource hungry, and the researcher might find it difficult to adopt a particular method based upon the findings gained from another. It may be ambiguous how to resolve the conflict that arises during the analysis and interpretation of the results (Creswell 2014).

4.2.4 ADOPTED RESEARCH DESIGNS

This research adopted an exploratory sequential mixed method to collect primary data to explore the challenges and issues associated with a cloud-based collaborative environment for online course provision by universities. The method used to collect data had two phases: the first phase collected and analysed qualitative data using semi-structured interviews, and the second collected and analysed quantitative data using a questionnaire. The rationale for using exploratory sequential mixed methods was to explore the challenges and issues before designing a framework to aid the establishment of a cloud-based collaborative environment for online course provision. The resulting framework and a prototype were evaluated using quantitative data.

The first phase of data collection was a series of semi-structured interviews conducted to explore the issues associated with cloud-based collaborative online course provision. The interviews were followed by two stages of questionnaires with both academics and students. The questionnaires were distributed for further investigation and to generalise the data collected from the interviews. The results of the two phases informed the development of the framework, and the prototype was developed to test a section of the framework. The framework was developed to facilitate the cloud-based collaborative environment between universities. Finally, the researcher distributed two survey questionnaires to evaluate the framework and prototype. Figure 4-1 shows the methodologies used in this research.

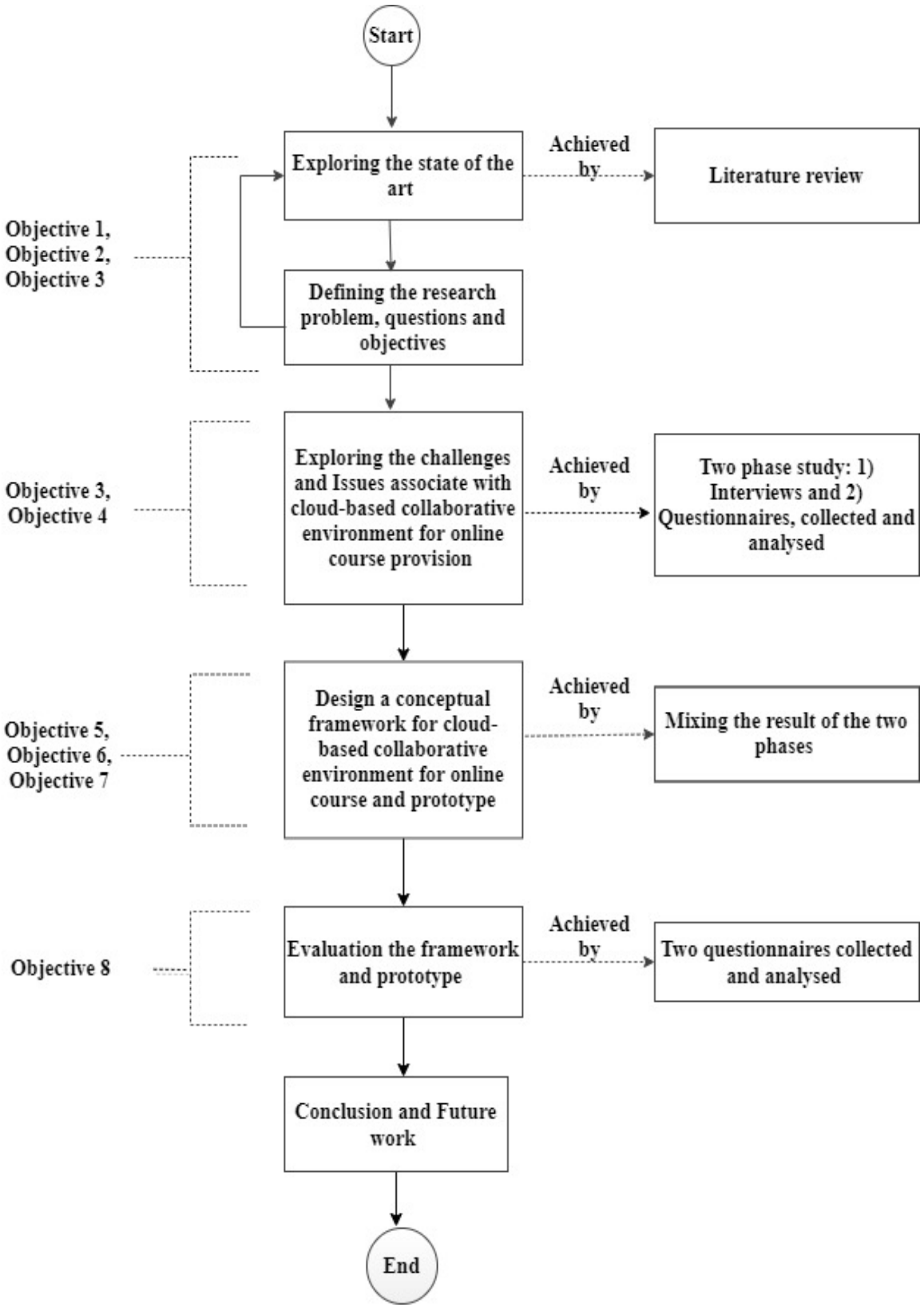


Figure 4-1: The design for the current research

4.3 RESEARCH METHODS

Research methods include the forms of data collection, analysis, and explanation that researchers implement for their studies. They involve a number of choices that the researcher needs to take in order to achieve the research objective and to answer the research questions. The selection of research methods can be affected by the research problem (Cohen 2013). This research used semi-structured interviews to gather qualitative data and questionnaires to provide quantitative data.

4.3.1 INTERVIEWS

Interviews were conducted to collect data related to research questions and objectives. The interview is a very useful method for conducting exploratory work before adopting a more complex study. Moreover, it can be used to create themes and groupings from the bottom up (Hakim 2000).

There are three types of interviews: structured interviews, semi-structured interviews and unstructured or in-depth interviews (Rayan et al. 2009). This research used semi-structured interviews in the first phase to collect primary data to help the researcher better understand the issues associated with online courses and explore universities' views about the cloud-based collaborative environments for online courses globally.

Semi-structured interviews provide a flexible approach to the interview process. They allow the researcher to have a predetermined list of questions to be covered in the interview. They also afford opportunities to gain more in-depth information about a specific topic. The rationale for using semi-structured interviews is that they give the researcher flexibility to ask additional questions during the interviews, to clarify participant's answers, collect complex detail, and obtain a better understanding (Berg 2009; Rayan et al. 2009). Researchers can use such interviews to explore difficult questions (Fylan 2005). They are conducted on a one-to-one basis, and the interviewer uses open-ended questions (Rayan et al. 2009).

4.3.1.1 POPULATION AND SAMPLING

The population is defined as "*the entire group of people, events, or things of interest that the researcher wishes to investigate*" (Sekaran and Bougie 2016, p.236). Sampling refers to the selection of part of the population (Sekaran and Bougie 2016). Qualitative research

focuses upon obtaining in-depth information about a topic, and for this reason qualitative studies use small sample sizes rather than large ones (Polit and Beck 2013).

There are two main sampling techniques: random sampling and non-random sampling. Random sampling methods provide every member of the population with an equal opportunity of being chosen randomly. Non-random sampling methods select from a large population non-randomly (Tansy 2007). Table 4-1 illustrates the advantages and disadvantages of using the random or non-random sampling methods (Tansy 2007).

Table 4-1: The advantages and disadvantages of random and non-random sampling (Tansy 2007)

Random sampling	**Non-random sampling methods**
Advantages: • To avoid selection bias. • Enable generalisation to a large group. **Disadvantages:** • The risk of excluding significant respondents due to random selection.	**Advantages:** • Managing the selection process. • Inclusion of important cases. **Disadvantages:** • The risk of selection bias. • A limited potential for generalisation to the broader population.

This study selected non-random sampling in order to obtain detailed information from the experts' point of view. For qualitative studies, there are different approaches to non-random sampling, including convenience, snowball, purposive, and theoretical sampling (Marshall 1996). Convenience sampling is used when researchers want to obtain potential participants that meet the criteria for data collection. This method is cost-effective with respect to time, money and effort but may not offer rich information to researchers (Polit and Beck 2013; Marshall 1996). Snowball sampling is an approach that is started by choosing one or more individuals from a population and asking them to nominate others to be a part of the sample. The drawbacks of this approach are that the final sample might be limited to a small network of acquaintances. In addition, the quality of the nomination sample may be influenced by whether the referring sample member trusts the researcher and would agree to collaborate (Polit and Beck 2013).

Purposive (judgemental) sampling is the most commonly used sampling approach in qualitative research. It allows researchers to select the sample carefully, which enables them to obtain detailed information needed for the study and to answer the research

questions (Marshall 1996; Polit and Beck 2013). Several strategies have been identified for use with purposive sampling, such as maximum variation sampling, extreme, typical case and criterion sampling. Maximum variation sampling "*involves deliberately selecting cases with a wide range of variation on dimensions of interest*" (Polit and Beck 2013, p.320). Extreme case sampling offers opportunities for learning from the most extreme informants. Typical case sampling involves choosing participants who can be expected to highlight what is typical. Criterion sampling requires studying a situation that meets a predetermined standard of significance. Theoretical sampling makes a decision about what data should be collected next and where to find those data to improve the research. This method aims to detect categories and their properties to present new insights into interrelationship that appear in the substantive theory (Polit and Beck 2013).

This study implements purposive sampling methods in order to obtain detailed information from the experts who are involved with online courses. Potential participants include heads of digital learning (distance learning) and academics. More details will be provided in Section 4.3.1.3.

4.3.1.2 SAMPLE SIZE

Sample sizes in qualitative research are much smaller than those used in quantitative studies. Frequencies are seldom significant in qualitative research, as one occurrence of the data is possibly as beneficial as many in understanding the process behind a topic. Furthermore, qualitative research seeks to gather in-depth information and effort and time are needed to analyse the data. Consequently, it is impractical to analyse data from large samples (Mason 2010). Suitable sample size to the qualitative studies when obtaining a sufficient answer to the research question (Marshall 1996). Qualitative studies focus mainly on sample adequacy rather than sample size. Sample adequacy means that the sample must be large enough to discover the important issues within the population and to raise a variety of points of view (Vasileiou et al. 2018).

Several researchers have provided recommendations regarding adequate numbers of participants for qualitative studies. Bertaux (as cited in Guest et al. 2006) noted that the minimum acceptable sample size for qualitative studies is fifteen. Dworkin (2012) mentioned that a large number of articles and books recommend that an adequate sample size is between five and fifty participants. Other researchers have recommended that the minimum sample size for phenomenological studies is six participants (Morse 1994).

Researchers try to reach saturation in the majority of qualitative studies (Mason 2010), but saturation can take a number of different forms depending on the research method in use. Theoretical saturation was developed for the method of grounded theory, while other forms are thematic saturation and data saturation. Researchers following thematic and data saturation principles continue to collect data until no new themes are generated (O'Reilly and Parker 2012).

The sample size selected for this study to reach the point of data saturation was sixteen. These were academics who were interviewed as experts involved in teaching or supporting online courses within different universities in the UK. After the analysis, sixteen was found to be an adequate sample size as there were diverse opinions on the challenges and issues investigated. Seven themes emerged from the interviews as challenges and issues that should be taken into consideration before adopting a cloud-based collaborative environment for online course provision between universities. The themes are discussed in Chapter 5, Section 5.1.

4.3.1.3 INTERVIEW STAGES

The qualitative data in this research were collected and analysed following the seven stages suggested by Kvale (1996), as shown in Figure 4-2.

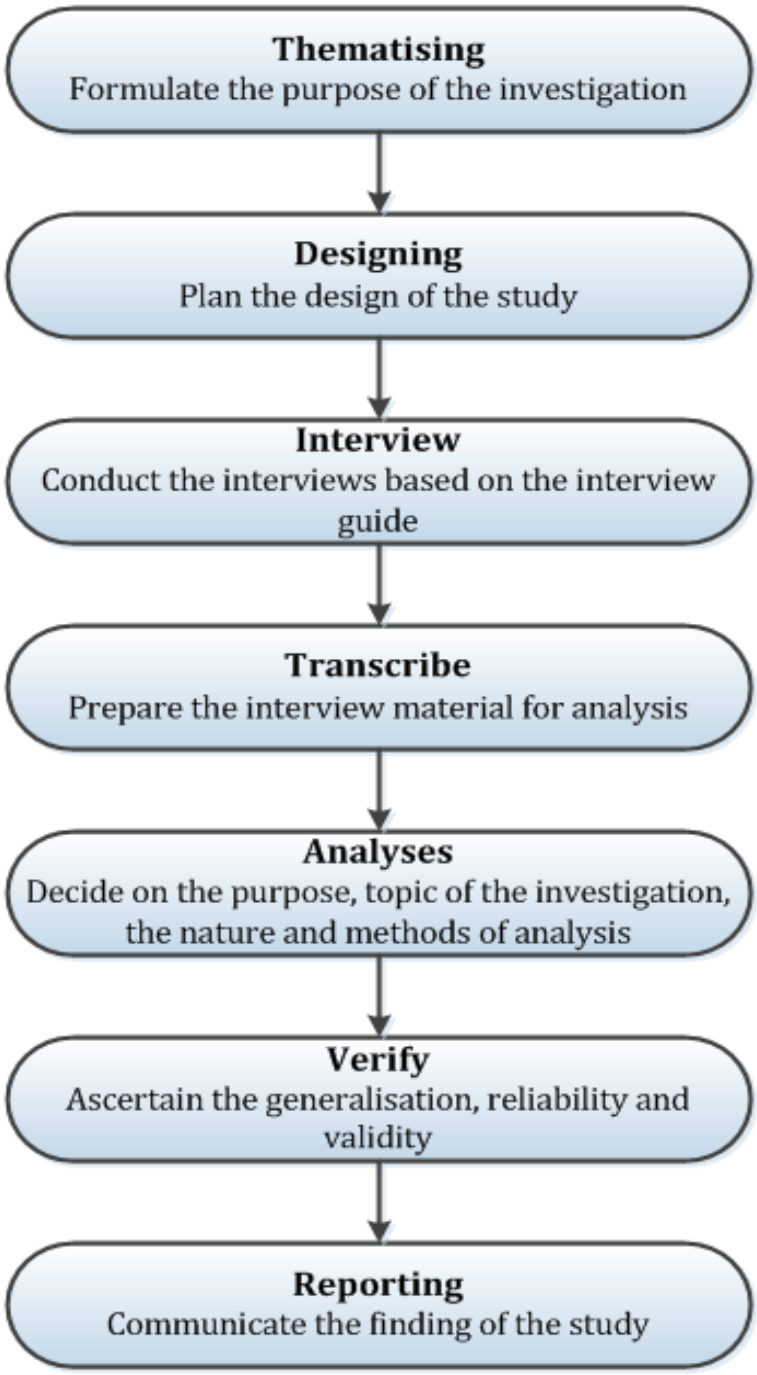


Figure 4-2: Stages of an interview investigation (Kvale 1996)

a) Thematising

A literature review provided valuable data regarding current issues with online courses, which helped the researcher to define the initial themes. Semi-structured interviews were then conducted to collect data within these themes and to explore new themes. The interviews aimed to investigate the challenges and issues that universities face when collaborating on the provision of online courses.

b) Designing

This research applied semi-structured interviews which used a pre-determined set of questions, as shown in Appendix A. The semi-structured interviews were conducted as a one-to-one dialogue. The interviews used open-ended questions to gain in-depth details from the participants' viewpoints. The pilot test was conducted with two academics from different universities which helped the researcher to identify both the positive and the negative aspects of the interview design. Pilot testing is a necessity because it facilitates the discovery of flaws or weakness in the study design and thus enables the researcher to correct the design before it is used (Turner, 2010).

c) Interviewing

This was the first survey for this thesis. Detailed information about potential participants was obtained prior to inviting them for interview. Only people with relevant experience who had been involved with online courses were invited for interview. They included heads of digital learning, product development managers and academics in distance learning.

One hundred and five invitation emails were sent to potential expert participants at different universities that deliver online courses in the UK. The email described the study aim and also included a participant information sheet and consent form. Sixteen participants responded to the invitation email confirming their willingness to participate in the study. The interviews were a combination of face-to-face, over the phone, or Skype meetings. It was possible to conduct face-to-face interviews with participants who resided in the same town as the researcher while Skype and telephone had to be used for those living in the UK but outside the local town. The face-to-face and Skype interviews enabled the researcher to make eye contact with the participants, view their facial expressions and observe their body language, which increased the researcher's understanding (Rayan et al. 2009).

An audio-recording device was used to record the interviews. The audio recording enabled the researcher to focus on the participants' answers during the interviews. The roles of the online course experts interviewed from different universities in the UK and other details are shown in Table 4-2.

Table 4-2: Details of participants used in interviews

Participant No	Position	Date	Methods	Duration
P1	Head of distance learning operations	28/07/2017	By Skype	35 minutes
P2	Head of distance learning	31/07/2017	By Skype	30 minutes
P3	Senior lecturer in IT service management	31/07/2017	By Skype	30 minutes
P4	Director of strategic educational development	02/08/2017	By Skype	30 minutes
P5	Director of distance learning units, operations	02/08/2017	By phone	40 minutes
P6	Head of educational technology	04/08/2017	By Skype	25 minutes
P7	Head of digital learning	10/08/2017	Face–to–face	30 minutes
P8	Product development manager	11/08/2017	By Skype	30 minutes
P9	Academic learning designer	15/08/2017	Face–to–face	35 minutes
P10	Academic in digital learning	18/08/2017	By Skype	30 minutes
P11	Head of the office for digital learning	21/08/2017	By Skype	30 minutes
P12	Senior learning designer	23/08/2017	By Skype	30 minutes
P13	Head of distance learning	28/08/2017	By Skype	35 minutes
P14	Head of academic development for digital education	30/08/2017	By Skype	30 minutes
P15	Associate pro-vice chancellor for teaching and learning,	31/08/2017	By Skype	30 minutes
P16	Academic in digital learning	04/09/2017	By Skype	25 minutes

d) Transcribing

The interviews were transcribed manually which was a long process requiring repeated listening and typing.

e) Analysing

Thematic analysis, "*a method for identifying, analysing and reporting patterns (themes) within data"* (Braun and Clark 2008, p.79), was used to analyse the semi-structured interviews. Here a 'theme' is not based on quantifiable measures but refers to "*something important about the data in relation to the research question and represents some level of patterned response or meaning within the data set*" (Braun and Clark 2008, p.82). Thematic analysis is the approach most commonly used to analyse qualitative data (Braun and Clark 2008; Marks and Yardly 2004). It has several advantages, including flexibility in relation to the way it is used, and the relative ease with which it can be employed to analyse qualitative data. It provides a rich explanation of the data set (Braun and Clarke, 2006). Thematic analysis has six phases (Braun and Clarke 2006), as shown in Figure 4-3.

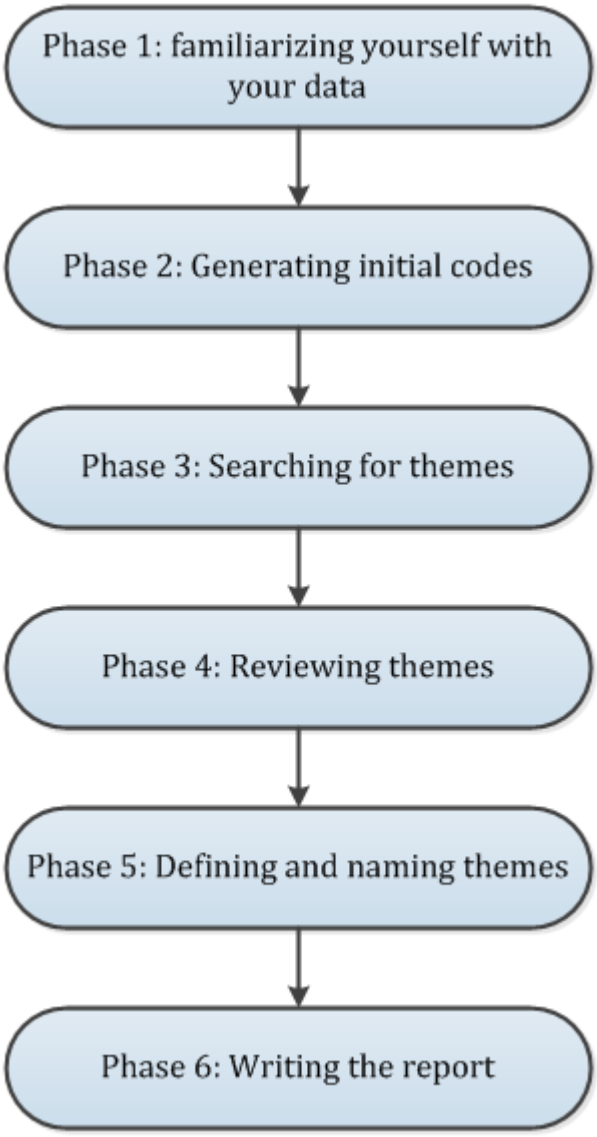


Figure 4-3: Phases of Thematic analysis (Braun and Clarke 2006)

Thematic analysis was used in this research. In the first phase, interviews were conducted, and the collected data was transcribed; this was then read several times to generate the initial ideas. In the second phase, initial codes were produced after reading the data. In the third phase, the different codes were categorised into themes, and the relevant codes placed in corresponding themes. In the fourth phase, the themes defined in the previous phase were revised. In the fifth phase, a definition for each theme was created. Finally, the report was written up, as will be discussed in Chapter 5.

The process of coding can be done manually or can be performed using software (Braun and Clarke, 2006). NVivo was the qualitative data analysis software used in this study to overcome the limitations of manual coding. NVivo facilitates the tasks of storing and organising data. It enables researchers who work with large volumes of

data to save time and focus on generating the codes and organised them under themes. Moreover, by avoiding human mistakes, Nvivo helps the researcher to gain more reliable results when compared with analysis conducted manually (Zamawe 2015).

f) Verifying

The credibility of a study rests on the validity and reliability of the results (Alkharang 2014). Validity refers to "*the degree to which a study reflects the specific concepts it aims to investigate*" (Alshenqeeti 2014, p.43). Reliability is "*concerned with the consistency, stability and repeatability of the informant's accounts as well as the investigators' ability to collect and record information accurately*" (Brink 1993, p.35).

The reliability and validity of the interview results were supported by the frequency with which participants gave the same response to interview questions. In addition, the participants chosen for interview were from different universities in the UK and were all experts in delivering online courses. Furthermore, the research adopted a mixed methods approach which led to a questionnaire in phase 2 of the current research, the results of which were used to generalise and test the data collected from the interviews.

g) Reporting

The results of the interviews are reported; these will be discussed in Chapter 5 Section 5.1.

4.3.2 QUESTIONNAIRES

According to Creswell (2014, p.124) a survey "*provides a quantitative or numeric description of trends, attitude, or opinion of a population by studying a sample of that population*". Questionnaires enable a large number of participants to be reached relatively easily. It is an economical method and analysis of the data gathered is straightforward.

The main reason for using questionnaires in this study was to generalise and provide a further investigation of the issues and challenges that emerged from the findings of the interviews (phase 1). There are seven stages that the researcher followed to design an effective questionnaire, as shown in Figure 4-4 (Kasunic 2005).

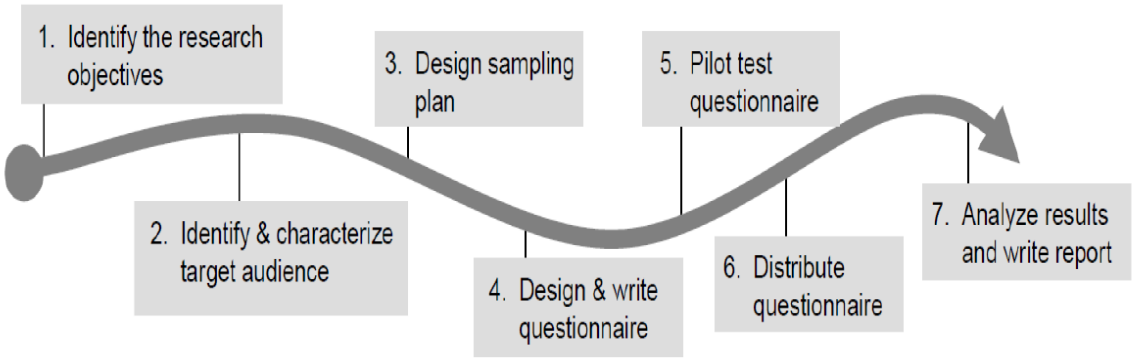


Figure 4-4: The questionnaire research process, adopted from Kasunic (2005, p.7)

a) Identifying the research objective

The rationale for using questionnaires within this project was to generalise and provide a further investigation of the interview results regarding the challenges and issues associated with the cloud-based collaborative environment for online course provision between universities.

b) Identify and characterise target audience

'Population' refers to all members of a specific group. A population can be defined with regard to geography, demography, occupation, time, or some mixture of these aspects. When the investigation determines the population of the study, then the target audience of the project is defined (Kasunic 2005). The definition of sampling and sampling techniques was discussed in Sections 4.3.1.1 and 4.3.1.2. A non-random sampling technique was chosen for the two questionnaires. The target population of the first questionnaire was the academic staff involved in online courses from different universities in the UK. The population for the second questionnaire was the students who join the online courses at the university.

c) Design sampling plan

Two separate questionnaires were used to collect data from academics and students who participated in the survey. The Yamane formula was used to determine sample sizes (Kasunic 2005). According to Williams et al. (2012), a sample size above 100 is appropriate for performing many statistical tests such as factor analysis, as suggested by statisticians. One hundred and twenty-eight completed surveys were received from academics and 130 from students. In the evaluation process (Chapter

8), two separate questionnaires for the framework and the prototype were distributed to the target audience. Twenty-seven responses in respect of the framework and twenty-one with regards to prototype were received respectively. The evaluation questionnaires employed a selective sample and small sample due to the sensitivity of research information that were intended to be viewed by the evaluator.

d) Design and write questionnaire

The two separate questionnaires were designed to obtain the views of academics and students regarding cloud-based collaborative online course provision. From the issues identified in the interview stage, a list of questions to be put to the academics and students was determined. Both questionnaires were divided into two parts; the first parts included the main questions and the second contained optional questions. For the academic staff questionnaire, the two parts were as follows:

1) The main parts contained 20 statements (items). A Likert scale with 5 response points (1 = Strongly agree, 2 = Agree, 3 = Neutral, 4 = Disagree, 5 = Strongly Disagree) was used. The number of items developed for each issue was as follows: Cultural aspects (7 items), Collaborative aspects (6 items), Management and administration aspects (2 items), Ownership aspects (3 items), Infrastructure and security aspects (2 items). This part also contained one open question.

   In addition, the questionnaire was divided into five sections, namely cultural aspects, collaborative aspects, management and administration aspects, ownership aspects, and infrastructure and security aspects.

2) The second part included three optional questions (age, gender, country of residence). The questionnaires are provided in Appendix D.

The students' questionnaire was as follows:

1) The main question part contained 11 items covering all aspects of interest from the perspective of students. Again, a Likert scale with 5 response points (1 = Strongly agree, 2 = Agree, 3 = Neutral, 4 = Disagree, 5 = Strongly Disagree) was used.

2) The second part included three optional questions (age, gender, country of residence).

A 5-point Likert scale was chosen because it is likely to increase the response rate, response quality and reliability (Bouranta et al. 2009). The 5-point Likert scales are significantly easier for the respondent to deal with and quick to answer (Pearse, 2011). The questionnaires are provided in Appendix F.

The questionnaires were made available to the participants using a web-based tool (SmartSurvey). The questionnaires were accompanied by an introduction on the first page which explained the purpose of the research. Furthermore, participants were assured of the confidentiality of the data gathered.

e) Pilot test questionnaire

The purpose of the pilot study was to examine the difficulty of the items and discrimination, response frequency and parameter estimation (Hertzog 2008; Johanson and Brooks 2010). As suggested by Kasunic (2005), the test was used to identify any possible strengths and weaknesses in the questionnaires before their implementation. It was also conducted to ensure a valid response to the survey and that it was possible to understand the questions (Holt 1997).

The pilot questionnaires for these studies aimed to avoid misinterpretation of the questions. Furthermore, the pilot study was used to evaluate the reliability and validity of the questionnaires. Three participants were tested each of the questionnaires. In general, the feedback from the participants showed that the questions in the questionnaires were understandable. A few minor amendments were suggested by the participants, which were then implemented. The amendments related to the format of the questionnaire only and not the content. The recommendations were implemented prior to the distribution of the main questionnaires to the target participants.

f) Distributed questionnaires

In addition to making the questionnaires available on the SmartSurvey website, the questionnaires were distributed to the target participants in various other ways. One of the main ways was by sending the link via email to academic staff and students who were joining online courses at the (29) universities in the UK that deliver online courses and the Open University. Other methods were used to distribute the questionnaires, such as contacting students and academic staff who were involved in online courses or online course groups on social network websites (Twitter and

Facebook). The questionnaires distributed to the participants between mid of November 2017 and March 2018. One hundred and five participants completed the academic staff questionnaires while 77 left the survey incomplete, providing partial responses. In addition, 130 participants completed the students' questionnaire, whereas 55 left it incomplete.

g) Analyse results and write the report

The Statistical Package for Social Sciences (SPSS) (Landau 2004) software version 25 was used to analyse the data, and then provide a summary using descriptive statistical analysis. The Mann-Whitney U-test was used to compare differences in views to test whether there were any significantly different views expressed by two different groups that were identified within the participant sample, for example dividing the participants into groups by gender. The Kruskal-Wallis H test was used to compare differences in views between three or more participating groups, for example dividing the participants into groups by age. This process is discussed further in Chapter 5.

4.3.3 FRAMEWORK AND PROTOTYPE DESIGN

Based on the results of the mixed methods approach, a conceptual framework was designed to help universities to take into consideration the challenges and issues prior to establishing a cloud-based collaborative environment for online course provision between universities. The framework included five main issues, which in this thesis are called elements of the framework. The elements are: quality, legal, security, operation and education. The framework also illustrated the relationship between each element. Each element includes a number of sub-elements. The framework is further explained in Chapter 6.

To test part of the framework, a prototype was designed. The purpose of the prototype was to illustrate some of its concepts in a collaborative environment for online course provision. In this prototype, university partners can check compliance with the process and avoid detrimental effects. The focus of the prototype was on course development and assessment processes. The prototype is discussed in Chapter 7.

4.3.4 EVALUATION OF THE PROPOSED FRAMEWORK AND PROTOTYPE

The proposed framework and the prototype were evaluated by a group of heads of educational technology departments and digital learning departments, and senior academic experts involved with online courses from computer science education departments and education departments were invited to give their views. There were two separate questionnaires used in the evaluation: one to evaluate the framework and one to evaluate the prototype. The method used for the evaluations was web-based questionnaires. Twenty-seven academic experts who were involved in online course provision participated in the framework evaluation, including heads of digital learning, heads of educational technology and senior academics in computer science education, while twenty-two of the participants left the framework surveys incomplete. In addition, twenty-one from the same group of academic experts participated and completed the prototype questionnaire while 24 left it incomplete. The questionnaires were sent to the target audience mainly via email. The frameworks survey that posed 19 questions included 13 Likert-type and 6 open-ended questions (see Appendix I). The prototype survey included a small number of items with 5-point Likert scores and an open-ended question (see Appendix J). More details about the evaluation studies are provided in Chapter 8.

4.4 ETHICAL CONSIDERATIONS

Consideration of ethical issues prior to data collection is a very important step because it protects the rights of participants and informs them about procedures and potential risks. Ethical considerations should be taken into account to ensure the integrity of the research, and attention should be paid to those considerations at all stages of the interview process. The Bournemouth University process for reflecting on ethical issues and applying for ethical approval was followed to ensure the proposed research activities complied with the institution's ethical code of practice and a number of measures were implemented to ensure the research was ethically conducted. For example, the participants were informed that the interviews would be recorded and that they could withdraw if this unacceptable. In addition, they were informed that the data obtained would be used for research purposes, and the results would be presented in a PhD thesis and in published academic articles. Covering pages were attached to the questionnaires to explain the purpose of the studies and giving the researcher's name and contact details. They included the following

statement on privacy and confidentiality: ‘All answers will be treated confidentially, and respondents will be anonymised’.

The number of ethical approval form for data collection using interviews and questionnaires is 16151. The participant information sheet that sets out the aim of the research and other information regarding participation in the study was sent to the interviewees and is included in Appendix B. The researcher also sent a consent form to the participants, which can be found in Appendix C. The interviews and questionnaire for collecting data are discussed in Chapter 5.

The two questionnaires were used to evaluate the framework and the prototype. In addition, a covering letter in the web-based questionnaire was used to introduce the aim of the study and the evaluation. The number of ethical approval form for the evaluation of the framework and prototype is 27843. The participants were informed that all responses would be treated confidentially and anonymised. The participant information sheet which explained the aim of the research and the evaluation and gave other information regarding participation in the study was sent to the participants and can be found in Appendix K. The evaluation of questionnaires and analysis are presented in Chapter 8.

4.5 LIMITATIONS OF THE STUDY

The primary data collection in the first phase of the study took a long time because the search for online courses and relevant staff, who were identified from their profiles and job titles, was time consuming. One hundred and five participants in different universities in the UK were contacted and invited to participate in the interviews, but only sixteen of them agreed to engage in the study. One thousand five hundred and fifty-four invitation emails were sent to the target audience (both academics and students) for the second phase but the researcher received responses from only 128 academics and 130 students.

In the evaluation questionnaires for the framework and prototype, the search for target experts in universities in the UK, Australia, Malaysia, the US, and Saudi Arabia took a long time because it involved reading through their profiles to identify their experience. Only twenty-seven responded to the framework and twenty-one to the prototype questionnaire.

4.6 SUMMARY

This chapter has explained the research methodology, philosophy, and research methods followed to improve our knowledge of the topic under study. The research used an exploratory sequential mixed methods approach to explore the challenges and issues associated with cloud-based collaboration for the provision of online courses. Primary data was obtained from academics and students in two phases. In the first phase, semi-structured interviews were conducted with sixteen heads of educational technology and senior academics experienced in teaching online courses. In the second phase, two different questionnaires were used to obtain the views of academics and students separately. Based on the primary data the conceptual framework was proposed, and a prototype was created to illustrate aspects of the framework. Finally, two questionnaires were designed to evaluate the framework and the prototype. The next chapter discusses the results of the analysis of the primary data.

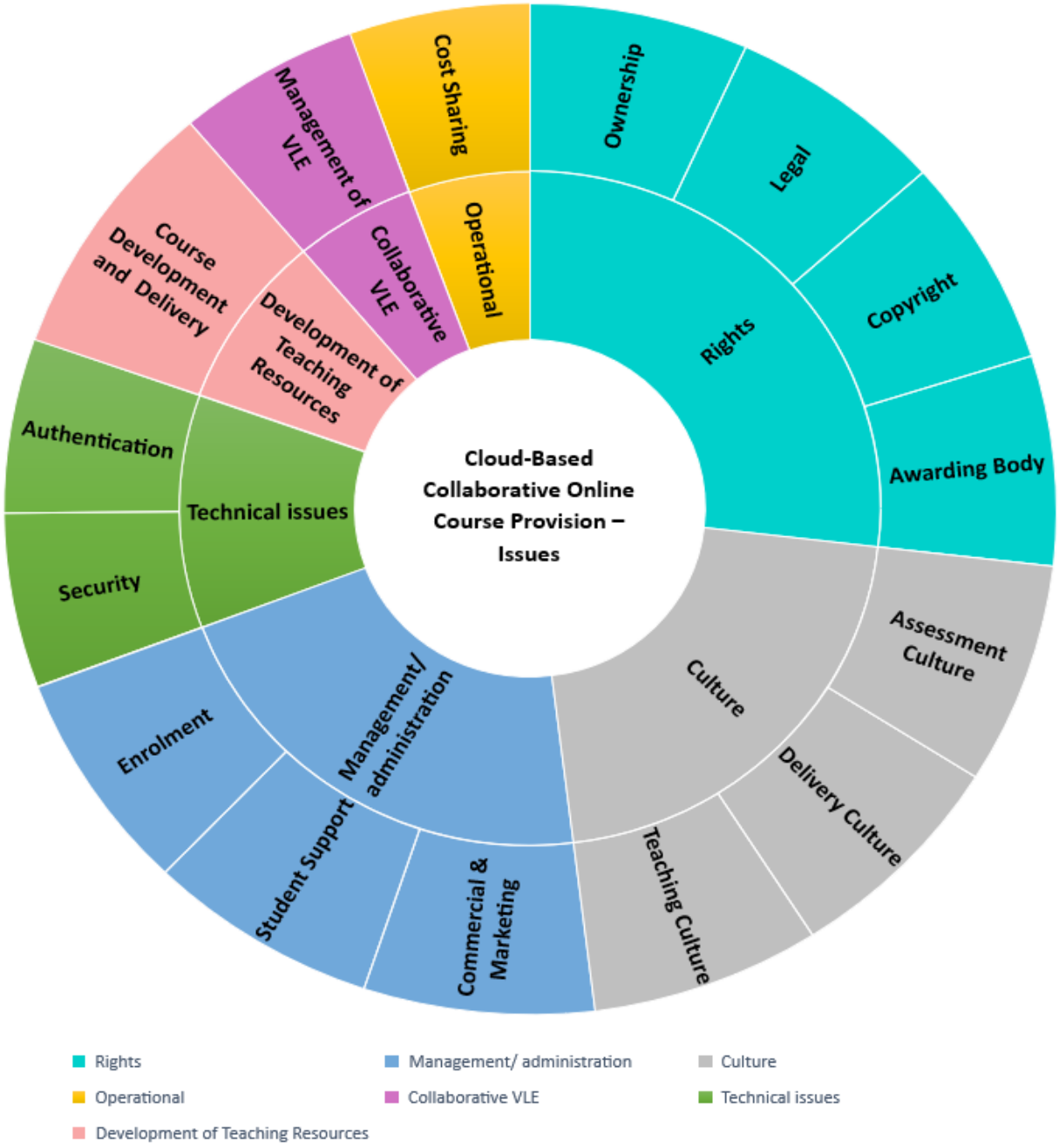
CHAPTER 5: FINDINGS FROM THE INTERVIEWS AND QUESTIONNAIRES

This chapter presents the findings from the data analysis of the interviews and two surveys questionnaires. It is divided into three main sections. The first section discusses the findings of the interviews. The second presents the quantitative results obtained from the survey data using SPSS. Section three in this chapter presents the discussion which merges the results of the interview findings, surveys result and literature review.

5.1 INTERVIEWS FINDINGS

In the first phase, sixteen academic staff, including heads of distance learning, were interviewed. During the interviews, the views of the participants with respect to a cloud-based collaborative environment between universities for online courses were explored.

Seven themes emerged from the analysis of the interviews that were conducted using thematic analysis (Braun and Clark 2008), as discussed in Chapter 4. They were rights issues, culture, management and administration, technical issues, development of teaching resources, collaborative VLE, operational. The seven themes are discussed below. Figure 5-1 shows the themes in the inner ring, highlighted using different colours, while the associated issues are shown in the outer ring, grouped within their corresponding colours.



Note: The sizes of the fields in the diagram do not indicate the relative level of importance. Each theme is identified by different colour.

Figure 5-1: Themes and Issues associated with cloud-based collaborative online course provision

5.1.1 RIGHTS

Rights was a main theme that involved a number of issues that could affect the decision whether or not to establish a collaborative environment for online courses. The issues

associated with the rights theme were labelled ownership, legal, copyright, and awarding body.

- **Ownership**

  Based on the inductive analysis of the data (Braun and Clark 2008), ownership is one of the issues related to rights, and it emerged as one of the vital issues that can influence collaborative environments between universities. The participants indicated that clarity of ownership would encourage the university to adopt cloud-based collaborative online course provision. For example, one of the interviewees asked the questions:

  > "*…who owns the content, who are the students, you know which university do they belong to or is it both, where did they graduate from?*" (Participant 4)

- **Legal**

  One of the main points raised by the interview participants was that of legal issues. A legal contract should be specified and agreed between the universities involved. Amongst other things, legal issues can include legal rights of ownership, who the students belong to, and which universities are responsible for enrolment. Therefore, no collaboration should be set up without identifying legal responsibilities. For instance, one of the interviewees stressed:

  > "*…With the collaboration, we need to set out the contract very clearly; we need to have a clear agreement with the partnership...*" (Participant 15*)*

- **Copyright**

  The participants were aware of procedures of copyright to protect lecturers' original work such as lecture, presentation, exam paper, etc. For example, one of the interviewees expressed the opinion that:

  > "*One of the challenges we would have would be with our academic staff, concerned about intellectual property and the course materials that may be taken by the other institutions and restructured and reused. I think that would always be challenged.*" (Participant 5)

- **Awarding Body**

  It is essential for universities to identify who would be the qualification awarding body. One of the interviewees asked for clarification:

  "*…where did they matriculate, where did they graduate from...?*" (Participant 4)

5.1.2 CULTURE

Culture emerged from the interviews as an important theme with several issues that may affect decision-making concerning a collaborative environment for online courses made available through the cloud. The three aspects of culture that emerged from the interviews were teaching culture, delivery culture and assessment culture.

- **Teaching Culture**

  The participants reported that lecturers might find collaborative approaches challenging as they would have to change their teaching style for online courses. One of the interviewees explained:

  "*…the single largest issue we will face is the culture, I mean our academic culture and what academic teaching [we are] used to. So we have people here who have been in teaching for a very long time and been a lecturer a very long time and in most cases are extremely good at it, and what we are asking them to do is teaching in a completely different* way…" (Participant 1)

- **Delivery Culture**

  Sharing resources and delivering online courses could be challenging, especially the first time. Lecturers need time to become accustomed to it. One of the interviewees stated:

  "*So just being aware there is a different way of delivering when we first launch the undergraduate online courses and that the first time doing it and just understanding the different way of delivery."* (Participant 8)

- **Assessment Culture**

  Collaborative assessment design and marking would be an issue because some lecturers might be reluctant to share their exam papers and marking. One of the interviewees indicated that:

"*...some academics are not willing to share their exam papers with others...*" (Participant 10)

5.1.3 MANAGEMENT AND ADMINISTRATION

The management and administration theme emerged from the interviews. Enrolment, student support and marketing were issues raised by the interviewees during the discussion.

- **Enrolment**

  One of the main issues that face collaborating universities is enrolment. The participants agreed that one university should be responsible for the enrolment process. One of the interviewees recommended:

  "*...so, there must be some control, so a student would enrol in a host university...*" (Participant 3)

  However, the other participants who mentioned enrolment agreed that the universities involved in collaboration should share the role of enrolment.

- **Student Support**

  Students who enrol for online courses need a different type of support to students who are studying on campus. The participants indicated that student support in collaborative courses would be an issue. One of the interviewees mentioned the following concerns:

  "I think the key here is really accurately, making sure the students who are studying at a distance get the same sort of level of support as face-to-face students if they are studying here." (Participant 12)

- **Commercial and Marketing**

  Collaboration between universities could have a positive influence on the marketing of the course. However, universities must be agreed on how to manage marketing before setting up the collaboration. One of the interviewees asserted:

  "I think that would be a good way to do it and sharing student experiences would be good but I think we have to be very careful about the commercial aspect of what we do." (Participant 3)

5.1.4 TECHNICAL ASPECT

The technical aspect was a theme raised by the participants which are divided between security and authentication issues.

- **Security**

  Adopting a collaborative environment for online courses through the cloud might raise security risks because users would not know where their data was stored on a cloud server. One of the interviewees affirmed:

  > "*I know that the system goes to a cloud server anywhere in the world, and in fact, as we increase our student population in different parts of the world*." (Participant 2)

- **Authentication**

  The participants commented on how to make sure that the students being assessed were the same students who registered on the course. It was remarked that lecturers could not normally develop the same relationships with students on online courses as with students they regularly meet in face-to-face sessions. One of the interviewees said:

  > *"Some people are worried about validation; in other words, knowing the person that you are teaching or assessing is the person you think they are because you do not see them.*" (Participant 9)

5.1.5 DEVELOPMENT OF TEACHING

The only issue with the development of teaching theme was course development and delivery.

- **Course Development and Delivery**

  Sharing the development of course design, development of courses and teaching resources would be an issue because few lecturers will have online course design experience. In addition, it is difficult for lecturers to change the way they design their courses from the traditional face-to-face mode. Online courses also require teaching resources which can be very different from the traditional face-to-face mode of delivery. One of the interviewees said:

"…It is not easy, … whether you're looking at HE or secondary schools or trainers standing up in the training room where people are generally given a brief: this is your audience, this the subject you're going to teach, this is the level you need to be teaching at, go away put together plan or presentation or whatever, and that's almost always done individually…" (Participant 1)

5.1.6 COLLABORATIVE VIRTUAL LEARNING ENVIRONMENT

Collaborative VLE was one of the themes that emerged from the participants' feedback. The management of that VLE was identified as a related issue.

- **VLE management**

  In a collaborative environment, universities should decide which will be responsible for managing the Virtual Learning Environment (VLE) tools and activities, and which university's VLE would be accessed by the students. One of the interviewees questioned:

  "…How is VLE going to be used? Are you going to use X University's VLE or Y University's VLE? How are you going to get the students to use the new version of the VLE environment? It is a reasonable idea but it is really difficult to implement…" (Participant 1)

5.1.7 OPERATIONAL

In respect of operational theme, cost sharing was raised as an issue:

- **Cost Sharing**

  The participants indicated that universities are willing to share costs. It is therefore crucial to have an appropriate agreement to apportion the costs between the universities involved. One of the interviewees stated:

  "I think the sharing of costs depends upon the nature of the agreement the institutions make." (Participant 7)

5.2 THE RESULT FROM THE SURVEY QUESTIONNAIRES

This section presents the quantitative results from the two questionnaires. The main reason for implementing the surveys was to verify and generalise the data collected by the interviews and to provide further investigation. Furthermore, the use of the questionnaires was to improve the reliability of the research. The following section provides discussions on the first survey, which investigated the views of academic staff with respect to issues concerning cloud-based collaborative online course provision.

5.2.1 DESCRIPTIVE STATISTICAL ANALYSIS – ACADEMIC STAFF

Descriptive statistical analysis was used for each statement/variable independently to summarise and describe the large amount of data collected. The median, which is the middle number when the measurements are organised in ascending or descending order, was used to indicate common points of view. The Interquartile Range (IQR) was also used, which is the difference between the largest and smallest values. It can be used as a measure of variability/dispersion (Boeree 2005). The number of participants who completed the questionnaire was 128. The participant response rates, using a 5-point Likert scale (1 = Strongly Agree, 2 = Agree, 3 = Neutral, 4 = Disagree, 5 = Strongly Disagree), their median and IQR shows in (Appendix E).

5.2.1.1 CULTURAL ASPECTS

According to Table 3, for statements 1 to 7 that dealt with important challenges to collaborative online course provision in terms of culture, it is clear that there is enthusiasm for collaboration between universities. Fifty percent of participants had no objection to sharing their teaching materials with colleagues in other universities. Approximately 78% of participants agreed or strongly agreed that working with academic colleagues in other universities is exciting which could provide opportunities for an exchange of experience and knowledge and to improve their skills, although nearly 76% of them indicated that can be challenging.

Overall, 63% of the academic participants agreed or strongly agreed that joint development of assessment materials between universities can enrich the quality of assessment. In total half of the participants agreed or strongly agreed that sharing the development of assessment could provide an opportunity to examine students' knowledge more accurately and effectively, whereas nearly 40% of participants' responses to this

statement were ‘neutral’. It is clear that the majority of the participants responded positively to sharing their assessment materials with academic colleagues in other universities. However, 70% of participants indicated that joint design and development of assessments between universities can be challenging. Figures 5-2 to 5-8 show the responses to statements 1 to 7:

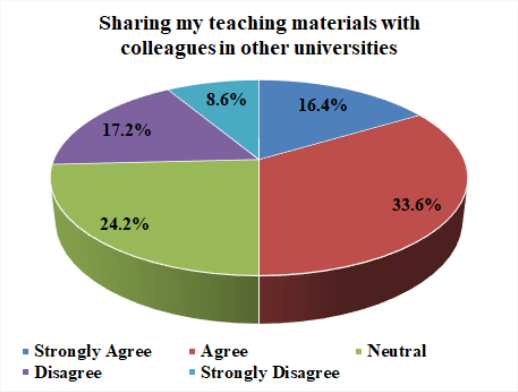


Figure 5-2: Sharing teaching materials with colleagues

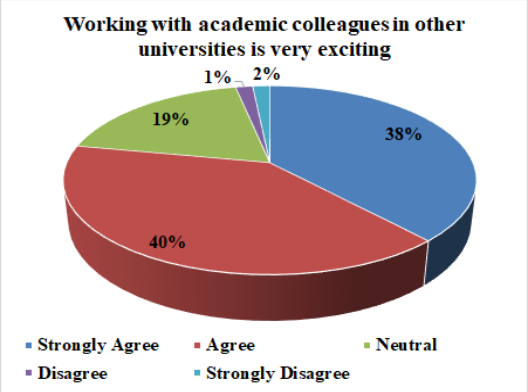


Figure 5-3: Collaborative working with academics

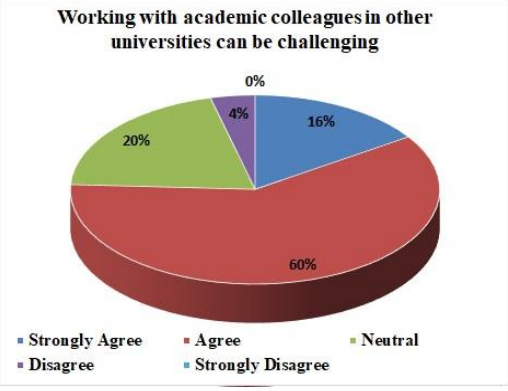


Figure 5-4: The challenge of working with colleagues

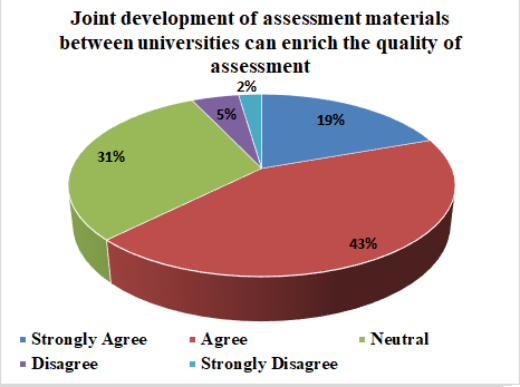


Figure 5-5: Sharing the development of assessment materials

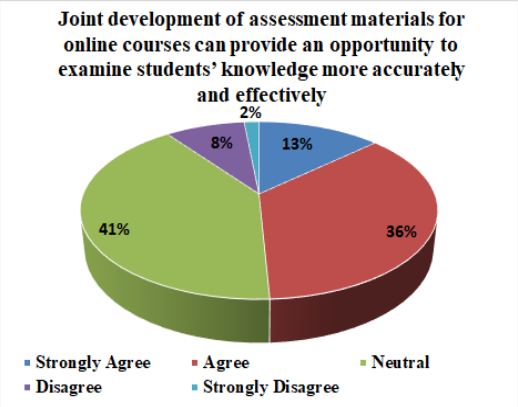


Figure 5-6: Relationship between sharing development materials and students' knowledge

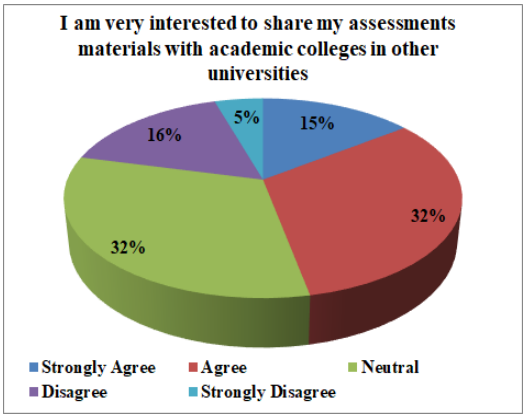


Figure 5-7: Academics' views on sharing assessment materials with colleagues

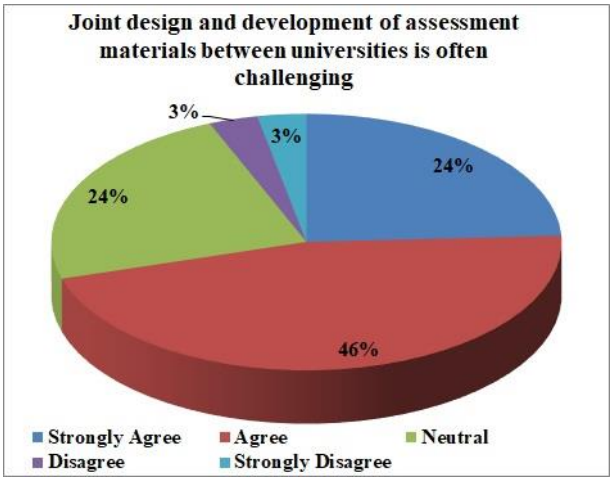


Figure 5-8: Challenges in the development of assessment materials

5.2.1.2 COLLABORATIVE ASPECTS

More than half of the participants agreed or strongly agreed that discussion boards are very helpful in encouraging students to exchange their knowledge and experience. Joint management of online courses between universities is one of the issues to consider. Overall, 45% of participants responded 'neutral' to the statement concerning whether it is more efficient and effective to share the management of online courses with collaborating universities. On the other hand, 43% of academic staff agreed or strongly agreed that sharing the updating and maintenance of teaching resources between the universities involved would be a good approach, whereas 42% of participants responded 'neutral' to the statement.

Similarly, 63% of participants agreed or strongly agreed that sharing the development of a course structure and agreeing on the approach to development or delivery between universities might be problematic. In total, half of the participants responded 'neutral' to the statement about whether sharing the development and delivery of online courses would be more cost-effective. In addition, more than half showed their agreement that a collaborative environment could enrich student support and experience due to the complementary knowledge which might be available. Figures 19 to 24 illustrate respondents' views with respect to statements 5-9 to 5-14.

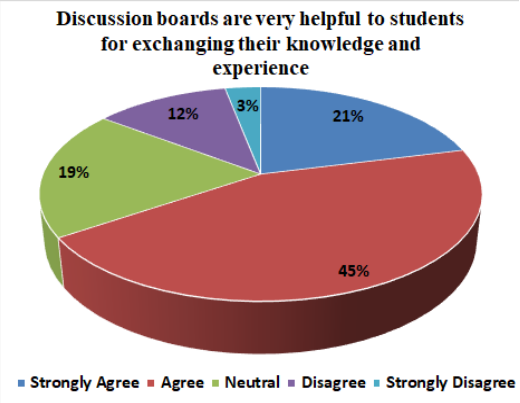


Figure 5-9: Discussion boards; helpfulness for students

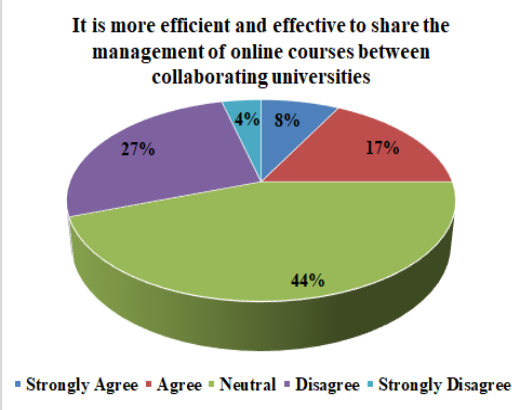


Figure 5-10: Effectiveness of sharing management resources

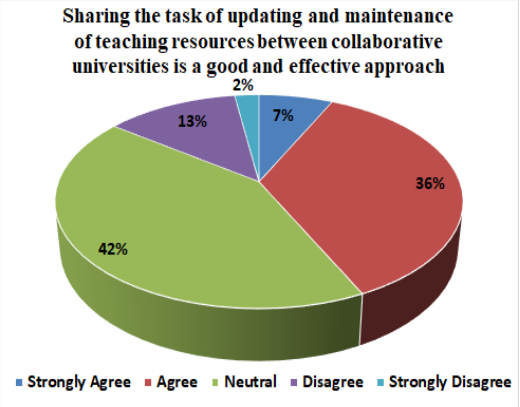


Figure 5-11: Efficiency of sharing the updating and maintenance of teaching resources

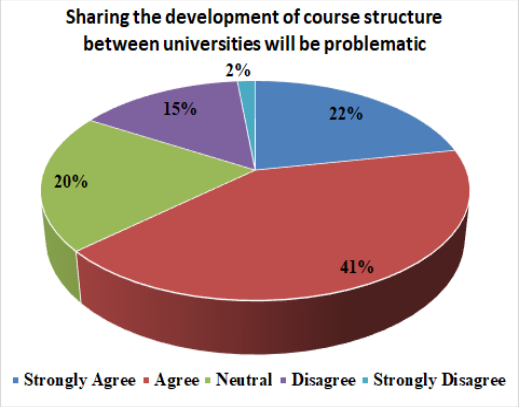


Figure 5-12: Issues associated with the development of course structure

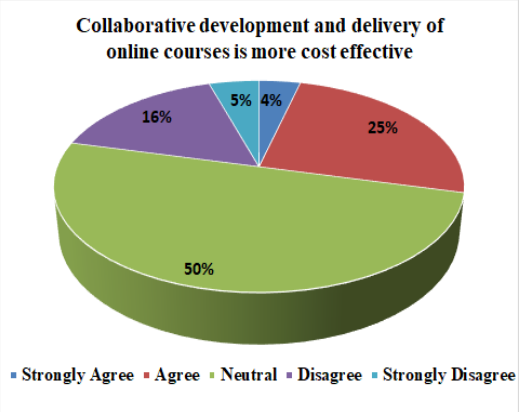


Figure 5-13: Cost-effectiveness of sharing course development and delivery

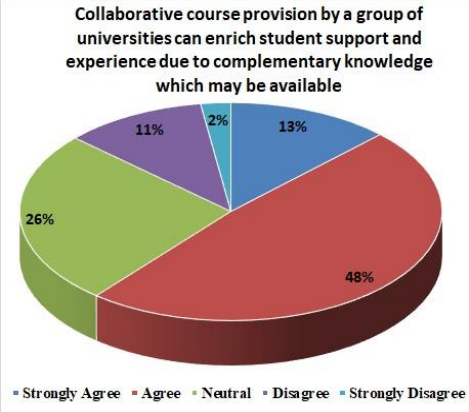


Figure 5-14: Collaborative provision and student enrichment, support and experience

5.2.1.3 MANAGEMENT AND ADMINISTRATION

It is interesting to note that 45% of participants responded 'neutral' to the statement that more than one university in a collaborative team should manage enrolment and administration for improved reliability. It was expected that the lead university would assume responsibility for managing the enrolments. Overall, 41% of participants responded 'neutral' to the statement that it would be more effective if the universities involved used their own student admission system, whereas 42% of participants either agreed or strongly agreed. Figures 25 and 26 show the outcome for statements 5-15 and 5-16.

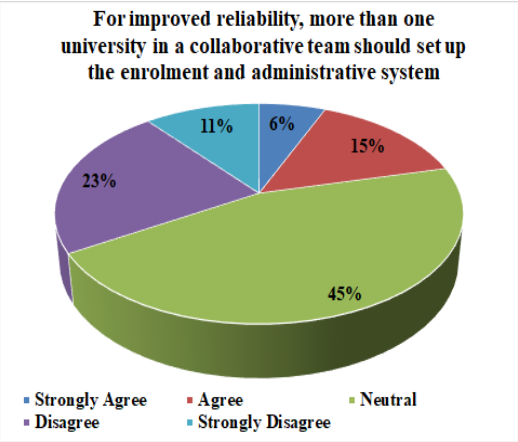


Figure 5-15: The sharing of enrolment to improve reliability

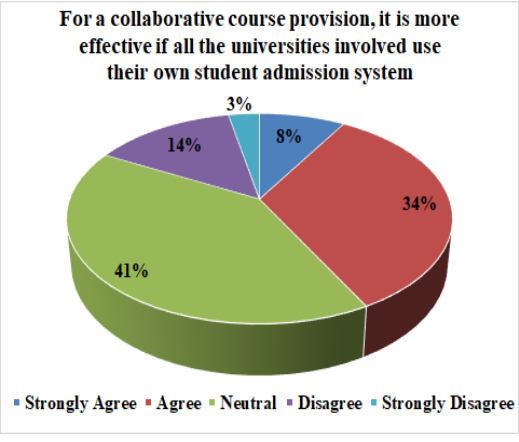


Figure 5-16: Use of own admission systems to maximise effectiveness

5.2.1.4 OWNERSHIP

In total, 91% of academics agreed or strongly agreed that ownership must be unanimous at the start of the collaboration. Approximately three-quarters of the participants agreed or strongly agreed that copyright issues could deter collaboration between universities. With regard to legal agreements, 69% of participants agreed or strongly agreed that contracts between universities must be signed prior to commencement of collaboration. Figures 27 to 29 show the outcomes for statements 5-17 to 5-19.

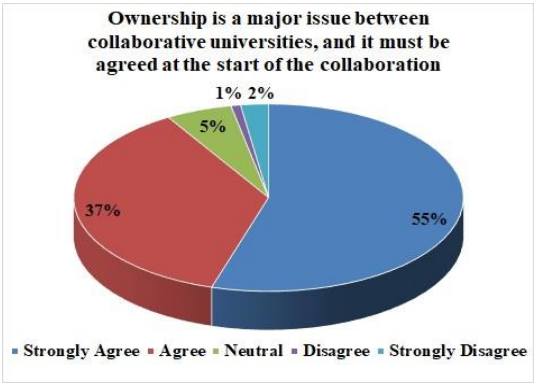


Figure 5-17: Ownership issues

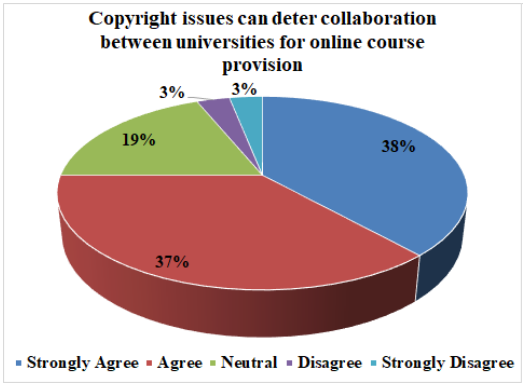


Figure: 5-18: Copyright issues

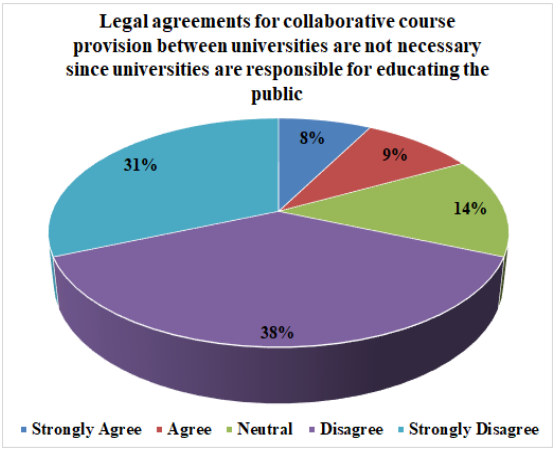


Figure 5-19: Legal agreements

5.2.1.5 INFRASTRUCTURE AND SECURITY

Only 38% of participants agreed or strongly agreed that universities should share the maintenance responsibility for VLEs, whereas 38% of participants disagreed that maintenance should be the responsibility of one university. Finally, 73% of academics had concerns about security issues in respect of student assessments and teaching resources which may be accessed via the cloud. Figures 30 and 31 show the outcomes in respect of the statements 5-20 and 5-21.

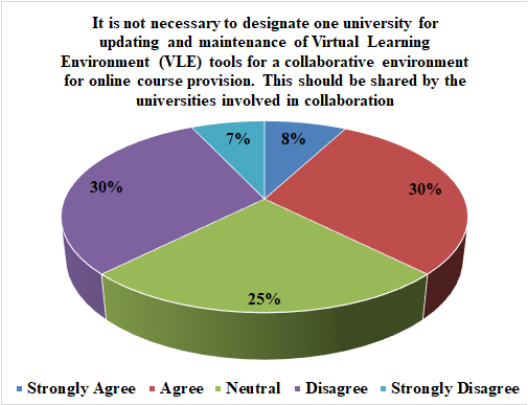


Figure 5-20: Cost-sharing for updating and maintenance of VLE tools

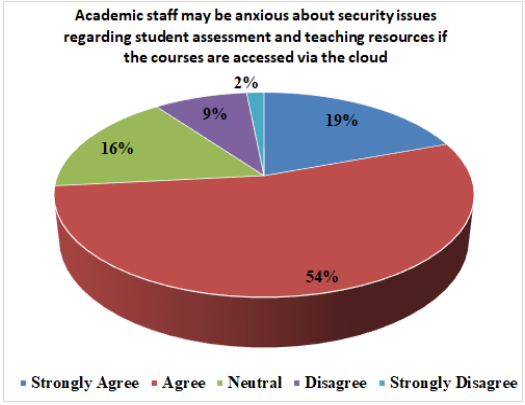


Figure 5-21: Security issues

The questionnaire for academics also included an open question, inviting "additional comments". Some of the participants commented that quality assurance would be an important issue in any collaboration between universities. They also suggested that the quality of courses should be taken into account in a shared environment. The compatibility regulations between universities from different countries should also be considered.

Furthermore, universities should be concerned about the collaboration between industries. The participants commented that legal arrangements, and contract and consumer laws would present barriers to the universities if they decided to adopt a collaborative environment. Furthermore, students' rights between universities involved in the collaboration should be considered. Confidentiality is one of the issues related to security that should also be taken into account.

- **Optional questions: Demographic information about participants**
    - **Gender:** As described in Chapter 4, the total number of participants was 128 (n = 128), consisting of 66 males and 62 females. Table 5-1 summarises the demographic information about the participants in this study.
    - **Age:** Participant ages can be divided into four categories, as shown in Table 5-1.
    - **Country of origin:** Where the academic staff come from, as shown in Table 5-1.

Table 5-1: Demographic information about academic staff who participated in the survey

Gender	Number	Percent
Male	66	51.6%
Female	62	48.4%
Age		
25-40	33	25.8%
41-50	38	29.7%
51-60	30	23.4%
61 or older	27	21.1%
Nationality		
United Kingdom	72	56.3%
Greece	16	12.5%
Australia	12	9.4%
India	9	7.0%
Germany	8	6.3%
Saudi Arabia	7	5.5%
United States	1	0.8%
Spain	1	0.8%
Libya	1	0.8%
China	1	0.8%

- **Reliability – academic staff survey**

Reliability is assessed by testing consistency and stability (Sekaran and Bougie 2016), and for this survey was measured using Cronbach's alpha. Cronbach's alpha "*is a reliability coefficient that indicates how well the items in a set are positively correlated to one another*" (Sekaran and Bougie 2016, p.289). The closer Cronbach's alpha is to 1, the higher internal consistency reliability (Sekaran and Bougie 2016).

In general, reliabilities less than 0.60 are considered to be poor, whereas those around 0.70 are acceptable. Reliabilities over 0.80 are considered to be good (Sekaran and Bougie 2016). The reliability test for the academic staff survey in this study was 0.794, as shown in Table 5-2, which means the reliability of this study is good.

Table 5-2: Cronbach's Alpha test – Academic questionnaire

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardised Items	N of Items
.794	.801	20

5.2.2 DESCRIPTIVE STATISTICAL ANALYSIS – STUDENTS SURVEY

This survey investigated students' views about the collaborative cloud-based environment for online courses. This part consisted of 11 statements. Descriptive statistical analysis was used for each statement independently to summaries and describe the outcome. The participant response rates, using a 5-point Likert scale (1 = Strongly Agree, 2 = Agree, 3 = Neutral, 4 = Disagree, 5 = Strongly Disagree), their median and IQR shows in (Appendix G).

Over 83% of the student participants agreed or strongly agreed that they are familiar with using online learning materials and approaches. More than half of the students indicated that they are familiar with online assessments. Figures 5-22 and 5-23 show the responses for statements 1 and 2:

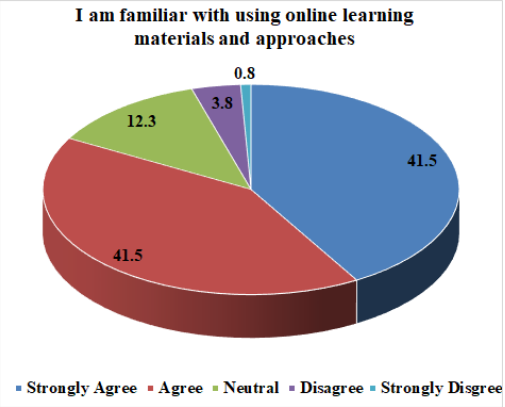


Figure 5-22: Students' familiarity with online courses

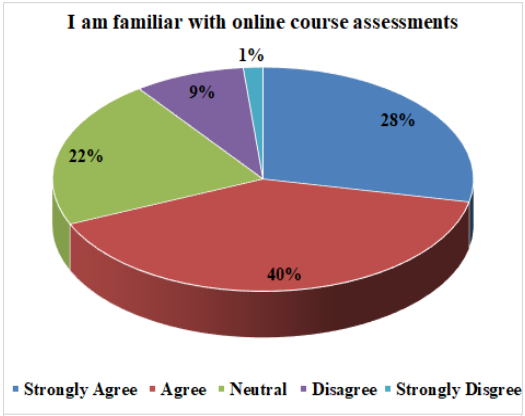


Figure 5-23: Students' familiarity with online assessments

Nearly 63% of the students were very keen to register for online courses provided by collaborating universities and believed that this would foster an enriched education. In addition, 68% of the participants agreed or strongly agreed that exchanging their experiences and knowledge with other students on the course would be beneficial. Figures 5-24 and 5-25 show the responses for statements 3 and 4:

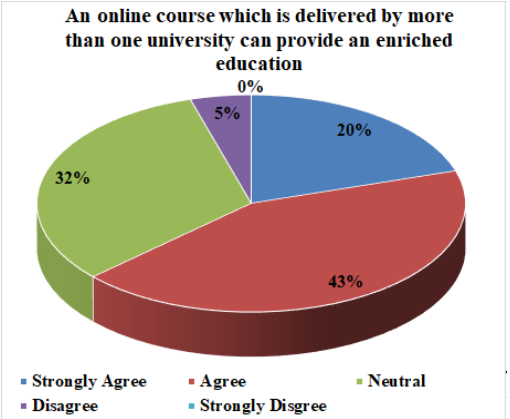


Figure 5-24: Collaborative online courses and education enrichment

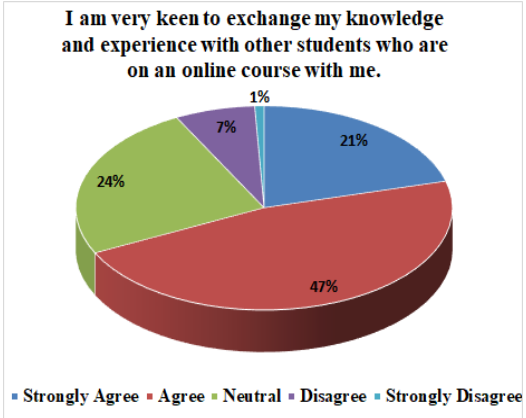


Figure 5-25: Student preparedness to exchange knowledge and experience with peers

Discussion boards can be used to support student communication with peers and academics to increase their understanding and knowledge. More than half of the students agreed or strongly agreed that they like to use discussion boards with other students to improve their ability to share their ideas and express themselves. Further, 73% of participants, as shown in Figures 5-26 and 5-27, agreed or strongly agreed that interaction with students from different cultures and backgrounds would encourage group discussions.

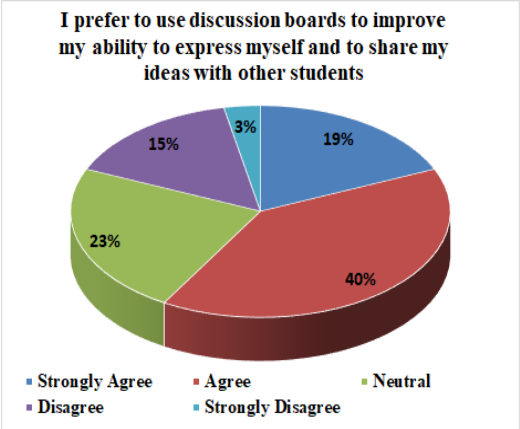


Figure 5-26: Using discussion boards to improve skills and share ideas with peers

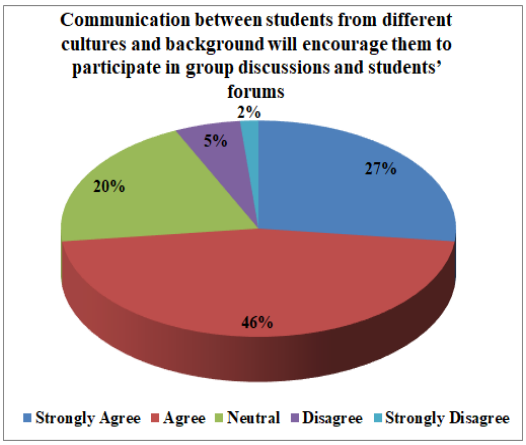


Figure 5-27: Encouragement due to communication

In total, 66% of the students agreed or strongly agreed that VLE tools enable them to improve their English language and technical skills. Over 43% agreed or strongly agreed that they were interested in participating in live group discussions during unsociable

hours, whereas 34% of participants selected 'neutral' in response to the statement. Figures 5-28 and 5-29 show the responses for statements 7 and 8:

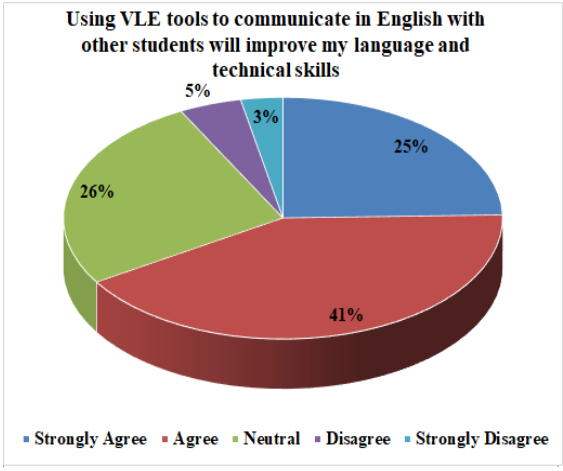


Figure 5-28: Using VLE tools to improve students' language and skills

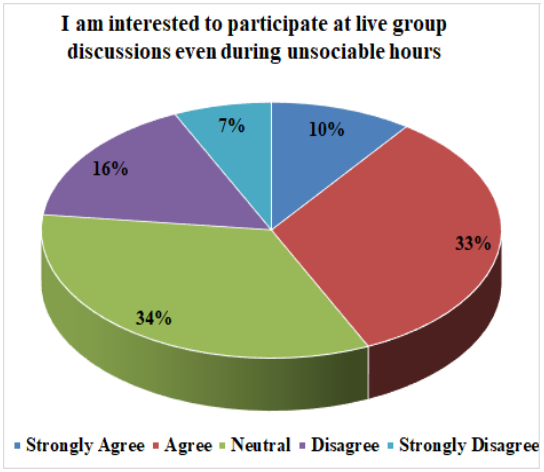


Figure 5-29: Participation in live group discussions at unsociable hours

Overall, more than half of the participants agreed or strongly agreed that collaboration between universities could positively affect students' decision to enrol for online courses. In addition, 65% of participants agreed or strongly agreed that support for students would be more effective between universities involved in a collaborative environment. Figures 5-30 and 5-31 show the outcomes for statements 9 and 10.

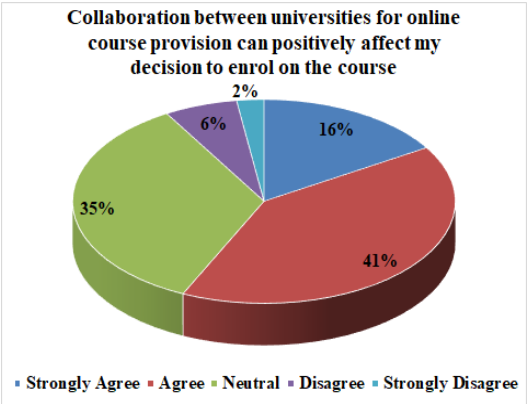


Figure 5-30: Collaboration between universities can affect students' decision to enrol

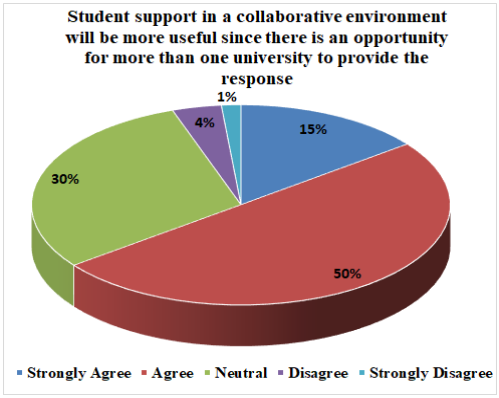


Figure 5-31: Effectiveness of student support in a collaborative environment

Regarding finance, 47% of students agreed or strongly agreed that the tuition fee would be an influencing factor if an online course were delivered by a group of collaborating universities, as shown in Figure 5-32.

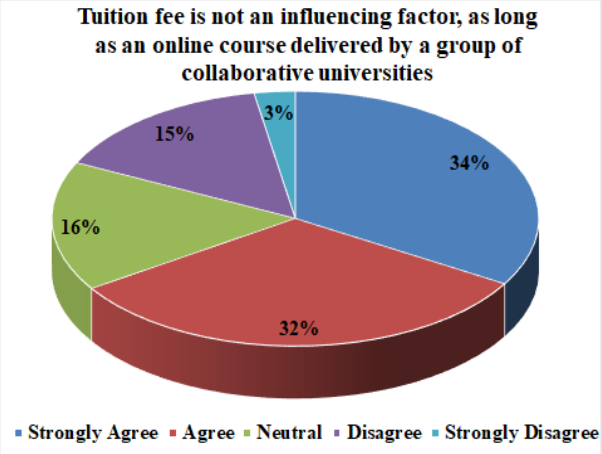


Figure 5-32: Tuition fee

- **Optional questions: Demographic information about participants**
  - **Gender:** As described in Chapter 4, the total number of participants is 130 (n = 130), consisting of 67 males and 63 females. Table 5-3 summarises the demographic information about participants in this study.
  - **Age:** Their ages can be divided into five categories, as shown in Table 5-3.
  - **Country of residence:** Where the students live, as shown in Table 5-3.

Table 5-3: Demographic information gathered by students' survey

Gender	Number	Percent
Male	67	51.54%
Female	63	48.46%
Age		
18-30	49	37.69%
31-40	61	46.92%
41-50	15	11.54%
51-60	3	2.31%
61 or older	2	1.54%
Country of residence		
United Kingdom	82	64.06
Saudi Arabia	29	22.66%
United States	2	1.56%
Australia	2	1.56%
Libya	2	1.56%
Pakistan	2	1.56%
Malaysia	2	1.56%
Canada	1	0.78%
China	1	0.78%
France	1	0.78%
Germany	1	0.78%
Italy	1	0.78%

Hong Kong	1	0.78%
Nigeria	1	0.78%
Oman	1	0.78%
Spain	1	0.78%

5.2.3 ANALYSIS OF DIFFERENT TYPES OF PARTICIPANTS

- **GENDER**

The Mann-Whitney U-test is used to compare the difference between the views of two groups (male and female) when dependent variables are ordinal scale. In this case, the independent variables are gender (male and female) and sample size (N = 130). The null hypothesis was rejected for statement 1 but was not rejected for statements 2 to 11. Table 5-4 shows the results of the Mann-Whitney U-test obtained using SPSS.

Table 5-4:The Mann-Whitney U-Test results for students gender (ranks and statistics)

No	Statements	Gender	N	Mean Rank	Asymp. Sig (2-tailed)
1	*I am familiar with using online learning materials and approaches*	Male	67	73.68	.006
		Female	63	56.80	
2	*I am familiar with online course assessments*	Male	67	68.37	.345
		Female	63	62.44	
3	*An online course which is delivered by more than one university can provide an enriched education*	Male	67	67.62	.480
		Female	63	63.25	
4	*I am very keen to exchange my knowledge and experience with other students who are on an online course with me.*	Male	67	62.63	.338
		Female	63	68.55	
5	*I prefer to use discussion boards to improve my ability to express myself and to share my ideas with other students*	Male	67	65.60	.973
		Female	63	65.39	
6	*Communication between students from different cultures and backgrounds will encourage them to participate in group discussions and students forums*	Male	67	60.70	.110
		Female	63	70.59	
7	*Using VLE tools to communicate in English with other students will improve my language and technical skills*	Male	67	60.02	.071
		Female	63	71.33	
8	*I am interested in participating in live group discussions at unsociable hours*	Male	67	64.07	.641
		Female	63	67.02	
9	*Collaboration between universities for online course provision can positively affect my decision to enrol on the course*	Male	67	61.22	.156
		Female	63	70.06	
10	*Student support in a collaborative environment will be more effective since there is an opportunity for more than one university to provide the response*	Male	67	62.99	.393
		Female	63	68.17	
11	*Tuition fee is not an influencing factor, as long as an online course delivered by a group of collaborative universities*	Male	67	60.81	.129
		Female	63	70.48	

In statement 1, “I am familiar with using online learning materials and approaches”, the distribution of the mean rank for male and female students appeared to be far apart, with a mean rank for males of (73.68) and for females of (56.80). The difference is statistically significant because the p-value is less than 0.05, as shown in Table 6 (U=1562.5, Z = -2.761, p = 0.006).

In statement 2, “I am familiar with online course assessments”, the distribution of the mean rank for male and female students appeared to be far apart, with a mean rank of 68.37 for males and 62.44 for females, as shown in Table 6. However, the results of the U-test found that the differences was not statistically significant as the p-value is greater than 0.05 (U=1918, Z = -0.944, p = 0.345). As shown in Table 6, with respect to statements 2 to 11, there were no significant differences between the responses of males and females because the p-value were greater than 0.05.

Therefore, it can be concluded that there was a statistically significant difference between males and females as males are more familiar with using online materials than females.

- **AGE**

In this study, age is an independent variable which is divided into five categories. The non-parametric Kruskal-Wallis H test was used to determine whether there were significant differences between the views of the five age groups. No significant differences were detected between the age groups for statements 1 to 11 (p-values > 0.05) (see Appendix H). Therefore, there was a widespread agreement between all student age groups in the responses to all the statements.

- **Reliability− student questionnaire**

The reliability test result for the student survey in this study is 0.773, as shown in Table 5-5. This means the reliability of this study is acceptable.

Table 5-5: Cronbach’s Alpha test – student survey.

Reliability Statistics		
Cronbach’s Alpha	Cronbach’s Alpha Based on Standardised Items	N of Items
.773	.777	11

5.3 DISCUSSION

The analyses of the semi-structured interviews and the two surveys provide in-depth information about the views of academics and students on the collaborative cloud-based environment for online course provision and the associated challenges. The results of the studies show that universities are keen to adopt collaborative environments that will facilitate a cost-effective, efficient and enriched educational environment, promoting a good student experience. Due to collaborative opportunities, joint course development between universities could improve academic skills and experience. In terms of joint teaching between academics, the quality for online courses could be enhanced, and the experience of academics improved. This would also encourage academic staff to change their teaching methods. According to McNair et al. (2016), collaborative teaching offers tutors' opportunities to share experiences with different academics. Moreover, sharing assessments between academics leads to improvement in their own skills and of students' performance. For example, academics could share the design of assignments to meet students' needs and also to support learning outcomes.

Collaborative learning can improve students' understanding, skills and knowledge. For example, students can share information and ideas through discussion boards with peers from different universities. Liaoa et al. (2014) stated that adoption cloud-based collaborative environment could bring to students' adequate support for the learning process. Therefore, students could get assistance from other students and instructors at the same university. While this research proposed to adopt the collaborative environment between universities which will bring to the students' better support for their learning process. El Mhouti et al. (2016) proposed a platform for the improvement of a cloud-based virtual collaborative learning environment to address the difficulties of optimising large-scale resource management. This was to support collaborative learning between students at the same university by mixing the advantages of VLE and cloud computing technology. The collaborative environment also would facilitate the sharing of teaching resources between academics which would save time.

However, the participants highlighted major issues that should be taken into account before adopting a cloud-based collaboration between universities. Legal agreements should be established prior to setting up any collaboration, to clarify the responsibilities of all parties. Ownership with respect to the course, students, teaching resources, and VLE, amongst other things, must be clarified at the start. Furthermore, copyright issues

should be considered. The participants commented that the contract between participating universities and legal compatibility between countries should be considered before adopting collaborative environments.

Security can be an issue, which requires attention. With a shared environment, universities need to secure student and staff access, and will therefore face challenges with the authentication processing of online students. In addition, confidentiality should be taken into consideration.

Universities should take into account the shared development of course design and course delivery between universities which should reach the universities education outcomes. They should also consider the challenges involved when academics need to work together to develop teaching resources. Collaborative work between academics in different universities should require the sharing of material resources, and the teaching culture, as well as the style of delivery. Universities must also consider the issues related to sharing design the assessment material, and development.

With respect to learning, students may face issues associated with using resources developed jointly by academics from different cultures with different learning styles. Universities should consider the challenges that students will face when communicating with peers from different cultures and backgrounds. They should also take into account the students' rights.

Universities should take into consideration sharing costs such as tuition fees, the costs of course development and maintenance, and of VLE, whilst also taking into account the management of online courses, including managing the VLE, and teaching and IT resources. They also need to consider the issues related to student support, technical support and enrolment.

Universities should also consider the quality assurance process, which should be agreed between them before starting the collaboration. They also need to consider the quality issues that related learning, teaching, assessment and course (Okogbaa 2016). Quality issues in university should also consider accreditation (Hoffman 2013). Accreditation aims to ensure the quality control, quality enhancement and accountability for the online courses and higher education institutions (Anaper 2013; Sanyal and Martin 2007). The participants also commented that the compatibility of regulation between universities should be taken into account.

To finalise the outcome of the interviews, questionnaires and literature review, the researcher grouped each related issues under the theme. The grouping themes were revised, and related issues were grouped together to become under five main themes as presented in Figure 5-33 and discussed.

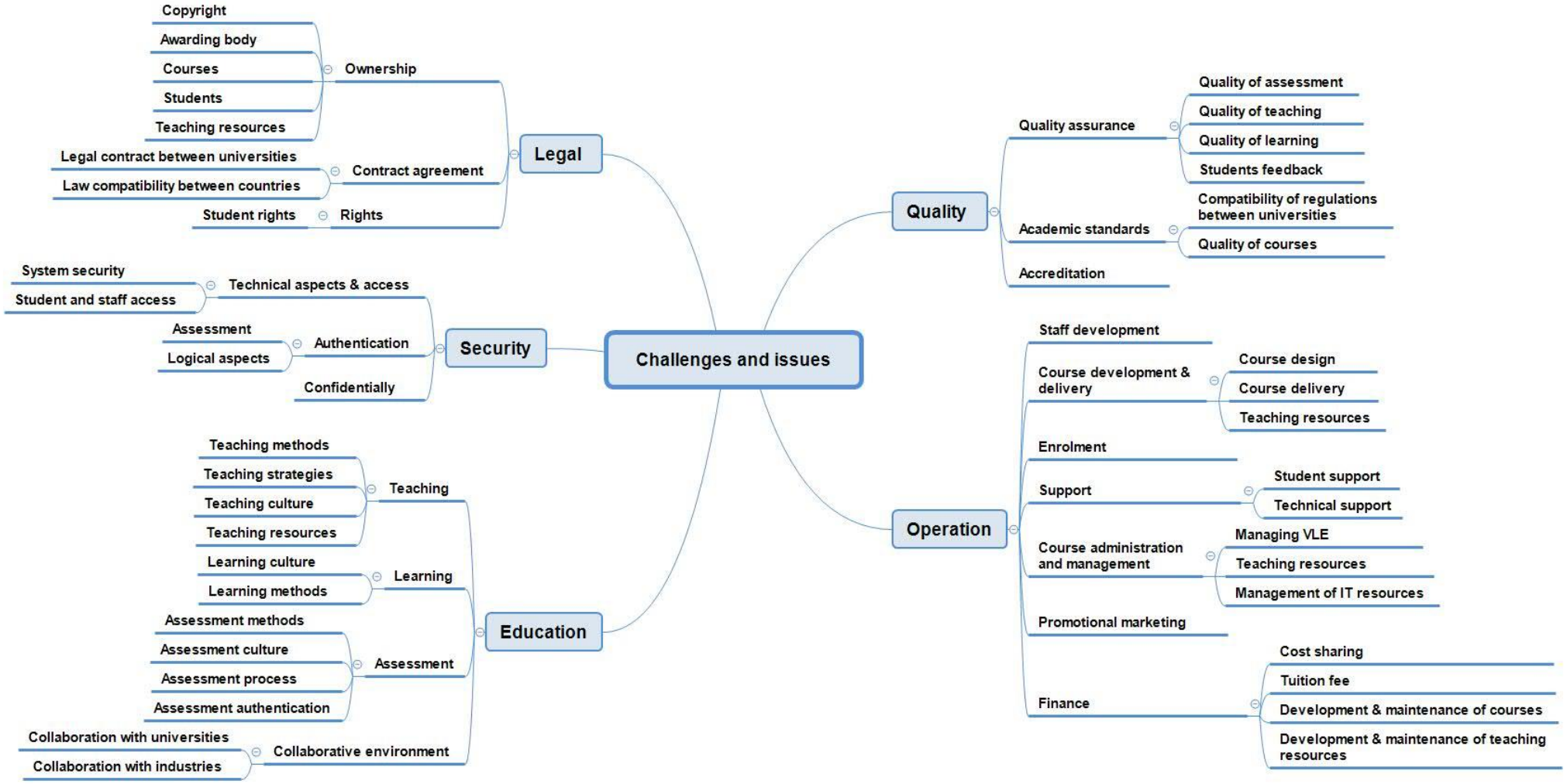


Figure 5-33: Theme, sub-themes, issues perceived by academics and students (interviews and questionnaires)

The issues relating to education were viewed from the perspective of culture in phase 1 (see Section 5.1) and phase 2 (see Section 5.2), but it has emerged as a major theme in phase 2 associated with learning and teaching strategies and style, as well as assessment that raised by the rating of statements in the survey questionnaire. The outcome of the surveys indicated that the collaborative environment with partners can be included in the education element.

The operational issues identified in phase 1 were predominantly concerned with cost sharing, while phase 2 identified a more comprehensive set of issues which were categorised as finance, as shown in Figure 43. Furthermore, the themes that were identified in phase 1, such as collaborative VLE, development of teaching resources, management and administration, and operational, are incorporated into the operation theme, as shown in Figure 43. Staff development in phase 2 is one of the challenges that arise from sharing course development between universities and is merged with the operation theme, as course development requires that staff are well trained and experienced.

The legal concerns that were identified as an issue within the rights theme in phase 1 along with the issues of ownership, copyright and awarding body have emerged as a separate theme in phase 2 as the issues raised by the rating of statements in the survey questionnaire. Thus, legal issues containing the ownership, rights and contract agreement (see Figure 43). In addition, as a result of the analysis of the two surveys conducted in phase 2, the copyright and awarding body issues were merged with ownership issues.

Security has also emerged as a separate theme in phase 2, involving technical aspects that were initially identified as a theme in phase 1. Security now includes authentication, confidentially and technical aspects and access. Similarly, quality has emerged as a theme after analysing the results of the second phase surveys, whilst it was not identified as a separate theme in phase 1. Quality includes quality assurance, accreditation and academic standards. These issues will be discussed in detail in Chapter 6.

5.4 SUMMARY

This chapter has discussed the analysis and results of the interviews and surveys employed in this research for collecting data. The two phases explore the issues which should be considered prior to adopting a cloud-based collaborative environment for online course provision. The issues that emerged from the interviews, questionnaires and literature review were grouped under five main themes. They are quality, security, legal, education and operation. Each theme has sub-themes that include a number of issues. The next chapter will discuss the framework for the cloud-based collaborative environment. The themes were redefined to become elements that make up the conceptual framework discussed in the next chapter.

CHAPTER 6: CONCEPTUAL FRAMEWORK FOR CLOUD-BASED COLLABORATIVE ONLINE COURSE PROVISION

This chapter presents the issues associated with cloud-based collaborative environments, as discussed in Chapter 5, the literature review and the evaluation survey, which was suggested by the evaluator and discussed in Chapter 8. The chapter describes the proposed conceptual framework for the delivery of a cloud-based collaborative environment for online course provision based on the outcomes of a mixed methods approach. The framework consists of five main elements: quality, legal, security, operation and education. The chapter explains each element and illustrates the relationship between them.

6.1 ISSUES ASSOCIATED WITH THE CLOUD-BASED COLLABORATIVE ENVIRONMENT FOR ONLINE COURSES

The two-phase surveys (Chapter 5) for collecting data, the literature review and evaluation survey (Chapter 8) identified a number of challenges and issues that should be taken into consideration prior to adopting a cloud-based collaborative environment for online course provision. The researcher grouped related issues together within five themes, as shown in Figure 5-33. The themes were redefined to become elements that make up the conceptual framework. Each element contains sub-elements, and each sub-element contains the number of issues. Some of the issues were added by the participants in the evaluation survey. Table 6-1 shows the grouped issues associated with cloud-based collaboration based on data gathering (discussed in Chapter 5), the evaluation survey (Chapter 8) and the literature review.

Table 6-1: Issues perceived by experts, academics, students and the literature review

Element	Sub-element	Issues
Quality	Quality assurance	Quality of assessment
		Quality of teaching
		Quality of learning
		Students' feedback
		Staff feedback
		Other stakeholder interests
	Academic standards	Compatibility of regulations between universities
		Quality of courses
	Accreditation	

	Technology	
Legal	Ownership	Copyright
		Awarding body
		Courses
		Students
		Teaching resources
		Data
	Rights	Staff rights
		Student rights
	Contract agreement	Legal contract between participant universities
		Compatibility of the law in different countries
		Cloud provider
		General Data Protection Regulation (GDPR)
	Ethical issues	
Operation	Staff development	
	Course development & delivery	Course design
		Course delivery
		Teaching resources
	Enrolment	
	Support	Student support
		Technical support
		Staff support
	Course administration and management	Managing VLE
		Teaching resources
		Management of IT resources
		Management of cloud resources
	Promotional marketing	
	Finance	Cost sharing
		Tuition fees
		Development & maintenance of courses
		Development & maintenance of teaching resources
		Financing for the cloud
Security	Technical aspects & access	System security
		Student and staff access
		Logging
	Authentication	Assessment
		Logical aspects
	Confidentiality	
	Integrity	
Education	Teaching	Strategies
		Culture
		Methods
		Teaching resources
	Learning	Culture

		Methods
	Assessment	Culture
		Methods
		Process
		Authentication
	Collaborative environment	Collaboration with industries
		Collaboration with universities
		Collaboration with students

The next section discusses the proposed framework in detail and clarifies the relationships between the elements.

6.2 PROPOSED CONCEPTUAL FRAMEWORK

A conceptual framework was developed based upon the results of a mixed methods approach to collecting data, an evaluation survey and a literature review. The framework illustrates how a particular element connects to other elements by showing the relationship between them. The purpose of the proposed framework was to identify issues which should be taken into consideration prior to adopting a cloud-based collaborative environment between universities. The framework contains five main elements based on the issues identified by expert academics, students and the literature review, as shown in Table 6-1. They are Quality, Legal, Security, Operation and Education. Each element is expanded into sub-elements and number of issues. As mentioned, the conceptual framework identifies the main elements and illustrates the relationship between them, as shown in Figure 6-1. The solid lines show the relationship between the main elements associated with a cloud-based collaborative environment, and the dotted lines show the relationships between the elements.

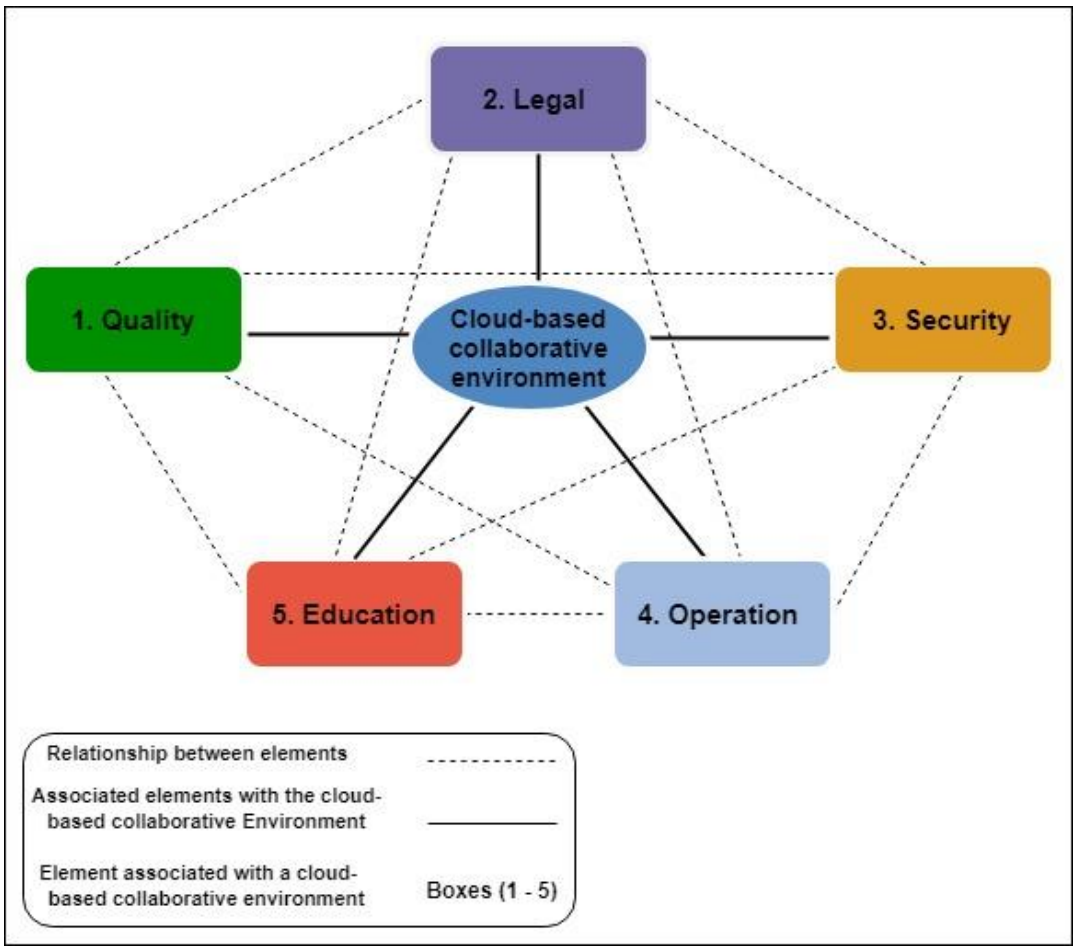


Figure 6-1: A conceptual framework for cloud-based collaborative online course provision

6.2.1 QUALITY

Quality is one of the main elements within the conceptual framework. The quality element includes issues such as academic standards, which are divided into the compatibility of regulations between universities and the quality of the course. In addition, it includes issues such as quality of assessment, the quality assurance process, teaching, learning, student feedback, staff feedback on students' work and other stakeholder interests. Accreditation by professional institutions is also one of the issues related to quality. Quality also has links with technology and is related to the Legal, Education and Operation elements, which will be discussed in the next section. Figure 6-2 shows the Quality element, its sub-elements and the influencing factors.

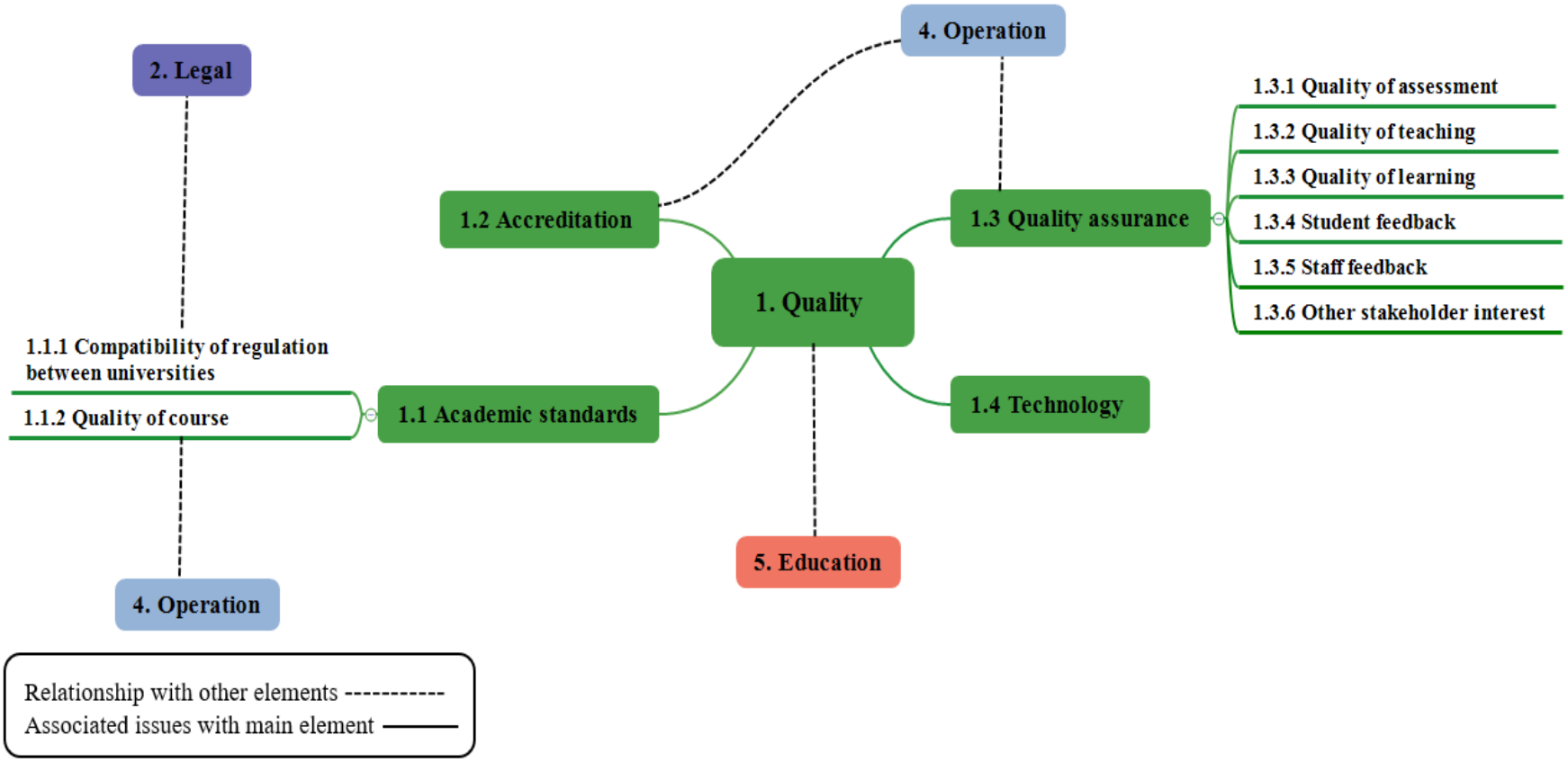


Figure 6-2: Quality element

- **Academic standards**

  Academic standards include the issue, compatibly of regulations between universities. Each university has its academic regulations and rules (The Open University 2020), which may be different from those of other universities in different countries. Such regulations relate to assessment, including the quality assurance process for assignments and examinations, amongst other things, for awarding degrees. They could also relate to things such as the appropriateness of assessment between universities, and the regulations relating to undergraduate and postgraduate degree requirements. Universities involved in a collaboration would need to specify and agree upon the regulations before offering an online course. The agreement for those regulations should be covered in the contract agreement (Legal element), as shown in Figure 6-2.

  The quality of a course should be ensured when it is shared between universities. The universities are responsible for assuring the implementation of standards and also the quality of the shared courses offered. They are accountable for managing the quality of their shared courses, ensuring that their students have a good educational experience, and for maintaining the standards associated with the value of the award.

- **Accreditation**

  Accreditation is another issue that is associated with quality. According to Wood et al. (2019), there is a relationship between accreditation and quality with regard to curriculum and course design within its influence on designing a curriculum. Universities involved in the collaboration should be encouraged to achieve accreditation for their shared online courses because they need to meet the high quality standards for education. Accreditation has a relationship with the operation element, especially with the issues of shared course design and delivery. The accreditation criteria and requirements should be reflected in course design and delivery (Wood et al. 2019).

- **Quality assurance**

  Quality assurance generally refers to the continuous process of evaluating the quality of a programme or a course, and of departments (Frank et al. 2012). Quality assurance in this study considers the quality of assessment, learning, teaching, student feedback,

staff feedback on students' work, and other stakeholder interests. In education, it should control the standards of teaching, learning and the assessment process which the students undergo, and it is one of the crucial issues that should be considered before adopting a cloud-based collaborative environment. According to (Alzafari and Ursin 2019) stated that each university has its policy, principles and processes for ensuring the quality of the courses it delivers. Thus, universities formulate their quality assurance system according to their own needs or national standards. This requires that universities involved in a collaboration should agree on appropriate policies and processes. One approach would be for those involved to accept and agree upon the policies and processes of one of the collaborating universities rather than to create a specific one.

Student feedback is one of the key pillars of the quality assurance process, gathering and publication of students feedback is a crucial element in several processes of quality assurance and improvement (Williams and Cappuccini-Ansfield 2007). Thus, the universities involved should specify and decide upon the most appropriate method of collecting student feedback and also formalise a process for academic staff to provide feedback on students' work. Staff feedback is one of the issues that should be considered, as the evaluator commented in the evaluation survey. In addition, they suggested that the quality assurance process should include other stakeholder interests, including those of employers, industry and alumni. The participants also commented that the quality assurance process includes the overall institutional evaluation process, which consists of all stakeholder surveys, employer and industry surveys. Universities involved in collaboration should ensure the quality of the resources that will be used, including forums, VLE, and teaching resources.

Quality assurance has a relationship with the education element. Thus, to enhance learning outcomes universities should perform quality assurance for teaching, learning and assessment. Universities should be particularly concerned about the quality of teaching resources which are shared between universities from different countries. Furthermore, they need to address the way in which the quality of assessments is to be measured. Collaborating universities need to discuss and agree upon the criteria that will ensure the reliability and validity of assessment methods.

- **Technology**

  Quality should incorporate technology, as pointed out by the participants in the evaluation survey. Technological applications are important to enhance the outcomes of learning and teaching in Higher Education Institutions (Shen and Ho 2020). Such Learning Management Systems (LMS) have been used to provide educational resources and enhance the quality of education (Fındık-Coşkunçay 2018; Shen and Ho 2020). Thus, the effective implementation of this platform is essential to developing quality of learning, access to educational resources and training (Fındık-Coşkunçay1 2018). Therefore, universities should take into account the quality of the tools and platform that will be used to deliver collaborative online courses.

  According to Ardanga et al. (2014), cloud computing has a challenge in quality of service (QoS) in terms of the levels of performance, availability and reliability of the applications, platform and infrastructure that host it. Quality of service is significant for cloud users, who expect that cloud providers will deliver a service as advertised (Ardanga et al. 2014). Universities should consider the quality of service of the cloud application which can be improved using techniques such as scheduling to control the demand on services. Admission control is another approach to taking control of cloud service performance, whilst resource provisioning can be used to deal with resource allocation (Ramadan and Kashyap 2017).

6.2.2 LEGAL

The Legal element is one of the main elements, and it includes a number of issues which are incorporated in the framework. They include contract agreement, rights, ownership and ethical issues as shown in Figure 6-3.

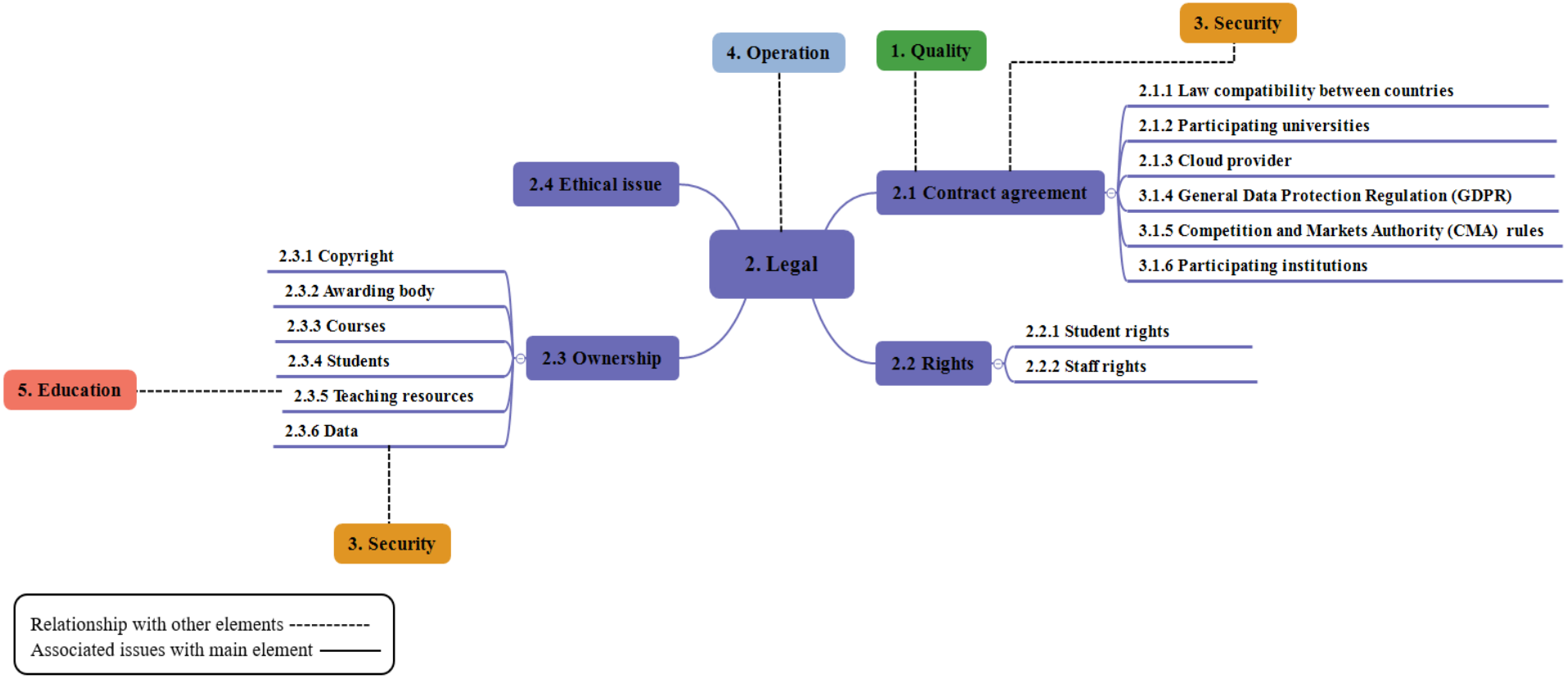


Figure 6-3: Legal element

- **Contract agreement**

A contract agreement would set out the responsibilities, polices, roles, rights and funding of collaborating universities and is one of the issues that should be discussed between the institutions involved in any collaboration. The contract should clarify the regulations and policies of collaborating universities located in different countries with a view to making them compatible. Furthermore, the whole contract agreement should be negotiated and agreed between participating universities before the start of the collaboration.

Participants in the evaluation survey commented that the cloud provider would be one of the key determinants in the contract agreement. Universities need to select a suitable cloud provider that will meet their expectations regarding provider characteristics and services, and should make a contract agreement with that provider. They should also select the cloud provider that supplies the best security for the data and system.

General Data Protection Regulation (GDPR), a compulsory regulation that increases the responsibilities of data controllers and data processors and established new rights for data subjects (Thelisson et al. 2018), is another important issue as suggested by the evaluators. Duncan (2018) states that attaining information security is a big challenge for organisations that use a distributed network system, but when they begin to use cloud computing, the challenge grows. The most challenging aspect that will face organisations with regard to GDPR is the cloud forensic problem (Duncan 2018). This problem occurs since all computing systems are always prone to serious attack (Duncan 2018). Therefore, GDPR is a part of confidentially within the security element.

Legal issues also include what is stated about a course, and this is controlled by, for example, the Competition and Markets Authority (CMA), that sets out rules on the contractual arrangement between online course provider and student. According to Warwick (2017), the CMA works to enhance competition to the advantage of consumers inside and outside a country and aims to make markets fully for consumers and the economy. The participants in the evaluation survey suggested that the

participating institutions should be considered and added into the contract agreements.

The system is used to secure online assessments should be set out in the contract agreements. In addition, universities need to decide which authentication mechanisms are appropriate for use. The contract agreement between universities should specify the process and rules for the quality element.

As shown in Figure 6-3, because of the relationship between the legal and operation elements, the contract agreement should clarify the financial contribution of each university involved. The universities that are responsible for the management and maintenance of the VLE should also be specified in the contract.

- **Rights**

  Students' rights are one of the challenges that arise in collaborative environments. Their rights and responsibilities should be established and agreed upon by the universities involved. Staff rights should also be taken into account, as suggested by the evaluators. It may be that some universities allow staff to retain certain elements of Intellectual Property (IP).

- **Ownership**

  Handling ownership within the legal element is one of the biggest challenges for universities. Ownership can be extended to include copyright, awarding body, the course itself, students, teaching resources, and data. Universities need to clearly identify the owner of the copyright and the teaching materials that will be used within the collaborative environment. They need to agree which institution owns the course and students, which universities will contribute to the delivery of the course and which university will award the qualification.

  The participants of the evaluation survey identified data ownership as an issue. Universities need to establish whether the data will be owned by either one of the universities involved or the cloud provider and to ensure the confidentially of that data if it is owned by the cloud provider. According to Chima (2016), institutions need to make sure that the chosen cloud provider fully encrypts the data that it stores for them on the cloud.

- **Ethical issues**

  Participants in the evaluation survey commented that ethical issues should be considered within the legal element. Satterfield and Kelle (2017) state that ethical issues in online education exist for course content, evaluation strategies and methods of engaging students. They also exist when determining the role of lecturers in the online learning process. Ethical issues even exist in determining the role of online educational establishments to access information or to create barriers to access. They are also present in determining student competencies when awarding degrees (Satterfield and Kelle 2017).

  Cloud computing technology can raise ethical concerns. Compliance, privacy and security become more significant ethical issues in the cloud. The cloud provider should set up specific rules in their Terms and Conditions regarding the ethical issues which must be taken into account (Faragardi 2017).

6.2.3 SECURITY

The third main element proposed in this research is security issues and consists of authentication, confidentially, technical aspects, access and integrity. Figure 6-4 shows the security element, its sub-elements and the number of issues.

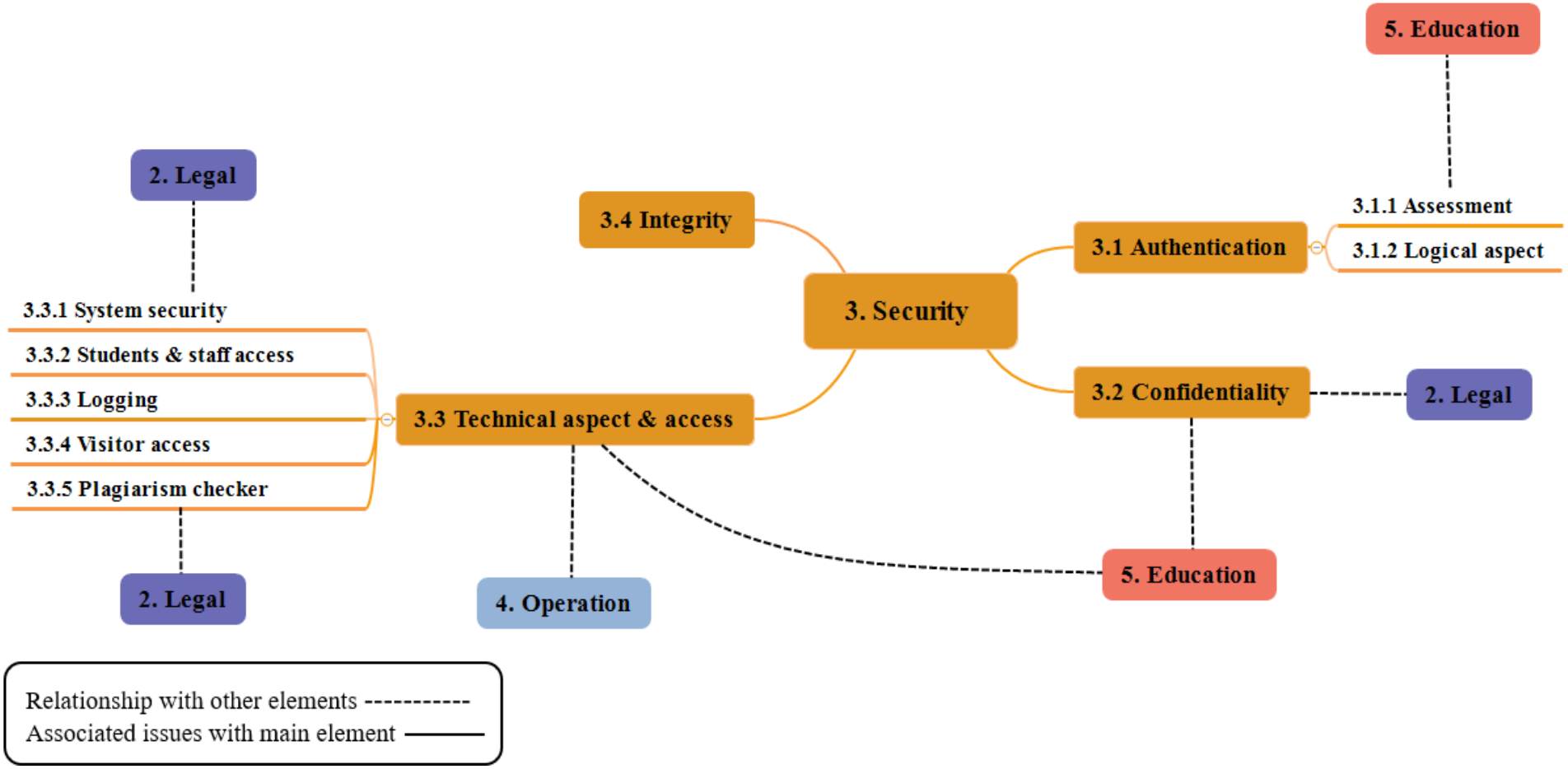


Figure 6-4: Security element

- **Authentication**

  Assessment authentication is the process used by a computer program or network to ensure the identity of a student who joins an online course, and such authentication must be taken into account prior to adopting the cloud-based collaborative environment for online course provision. Assessment authentication is relevant to the assessment process in education. Universities need to ensure that the student who is taking the assessment is the same person who is registered on the course, thus they need to specify the techniques used to enhance authentication for online examinations. Ali et al. (2016) present an approach that could be used for online assessment authentication. One method involves biometric systems such as fingerprint recognition, face, iris, ear shape and skin reflectance comparison. In respect to the logical aspect related to authentication, universities must also look at mechanisms to protect data from unauthorised access (Ali et al. 2016).

- **Confidentiality**

  With the sharing environment, universities should be concerned about how to protect sensitive information about assessments, students and staff. In addition, they need to take into account the security issues related to communication tools, including forums and discussion chat. Data in cloud computing is stored on a remote server that may be owned or operated by a third party and accessed via the Internet. According to Tianfield (2012), the threat to data will increase in the cloud due to the growing number of parties, devices and applications that leads to an increase in the number of access points. Universities need to protect themselves against confidentiality issues by selecting a good cloud provider that affords a high level of security. They should adhere to confidentiality agreements between collaborative universities and cloud providers to ensure an appropriate level of data security is maintained.

  The participants in the evaluation survey commented that there is a link between confidentiality and assessment in the education element. For example, the networks should be secure enough to facilitate the confidential performance of all assessment activities including marking, blind marking, peer review and formative evaluation.

- **Technical aspects and access**

  Technical aspects and access are related to technical support in the operation element. With the shared environment, universities need to pay more attention to security with respect to student and staff access to the collaborative environment. Participants in the evaluation survey commented that universities might need to consider how the student can access modules for their studies, and what types of users are allowed access to different materials. Furthermore, they stated that universities should take into consideration secure logging on to the VLE, and that they need to take into account visitor or guest access. They suggested that universities should also consider plagiarism checking software, and should specify the software that they will be using. The security mechanisms used should be agreed upon between the universities and specified in the contract.

  The participants in the evaluation survey mentioned that there is a link between the technical aspects and access and the education element. Education and course curricula should be designed for online learning with an appreciation of the technical dependencies of the environment. For example, an assessment may require a file submission that might not be supported in the online environment due to file type or size; this is to be avoided.

- **Integrity**

  In the evaluation survey, the participants mentioned that security, as an essential issue, should include integrity and availability. Data integrity risks may affect the accuracy and reliability of the information stored in the cloud. Since the data are outsourced to a remote server, the data integrity should be continuously checked and maintained to verify it (Aldossary and Allen 2016). The data might be lost or changed by unauthorised users since the cloud is untrustworthy. Sometimes data could be modified accidentally. There are two common techniques for verifying the integrity of data outsourced to a remote server. One is downloading the file and verifying the hash value and the second is to compute the hash value in the cloud by utilising a hash tree (Aldossary and Allen 2016).

6.2.4 OPERATION

Operation is the fourth main element associated with the cloud-based collaborative environment for online course provision. It includes issues related to course development and delivery, staff development, support, student enrolment, promotion/marketing, course administration and management, and finance, as shown in Figure 6-5.

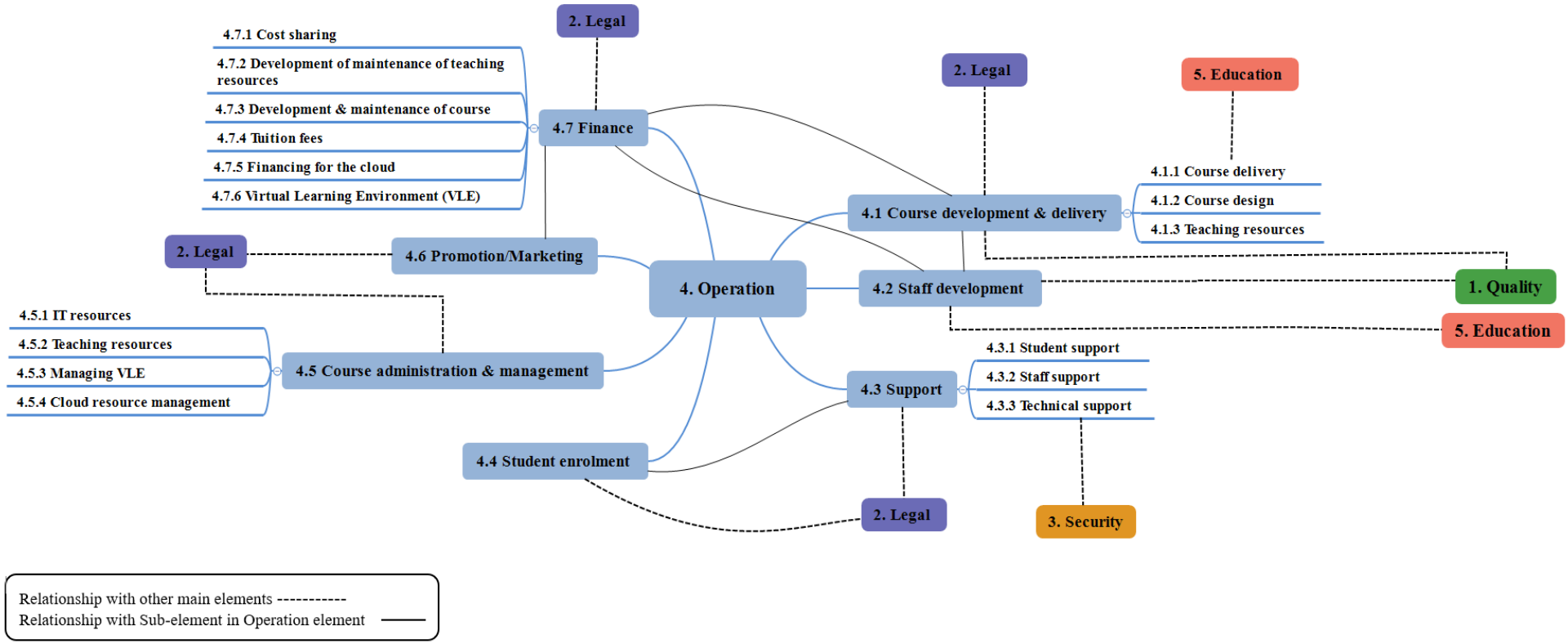


Figure 6-5: Operation element

- **Course development and delivery**

  Course development and delivery are joint activities between universities which can lead to well-designed courses, offering high quality learning to students. In order to ensure high quality, there are three associated issues – course design/development, delivery, and teaching resources – that have to be managed. Thus, universities have to ensure that the education outcomes after developing and reviewing the course meet the expectations of the universities involved. Further, they need to discuss which university is responsible for the review process and course maintenance. In addition, participants in the evaluation survey mentioned that there are delivery costs that should be taken into account, as well as how the universities choose to distribute those costs.

  In terms of course development, the challenges are from two different perspectives; course design and teaching resources. Universities should consider how course design can be shared in a manner that fits with their strategies. In addition, academics will be faced with challenges while developing teaching resources in collaboration with other universities. They need to ensure the quality of teaching resources and should also protect their copyright.

- **Staff development**

  In the operation of the collaborative environment, universities will face challenges with regards to staff development, which is related to the quality and education elements. Staff training and development will influence the quality of delivery and also student experience. Universities should consider sharing knowledge and experience between their academic staff to ensure improvement in their skills. They should consider suitable training courses for their staff to guarantee the quality of teaching and learning (Ödalen et al. 2018). They also need to ensure the quality of training courses that promote sharing of course development. The participants in the evaluation survey stated that the development of staff has a financial cost which should be considered.

- **Support**

  In terms of the challenges faced when providing student support, the roles and responsibilities of staff in the universities need to be discussed and agreed in a legal

contract. Technical support is one of the issues that universities will face, and it refers to any assistance in addressing a technical problem that is offered to online students (Netanda et al. 2017). Collaborations need to decide which universities are responsible for technical support. In the evaluation survey, the participants commented that staff support should be added to the support sub-element and should be considered within the collaborative environment.

- **Student enrolment**

  Enrolment challenges refer to the enrolment processes and responsibilities that academics find problematic, and they vary from person to person. Thus, to address these challenges, the responsibilities should be discussed between universities and agreed in the contract.

- **Course administration and management**

  In terms of course management, universities will face challenges involving the administration of IT resources, VLE, teaching resources and cloud resource management. The consortium should agree which university will be responsible for managing the IT resources. Also, the university responsible for managing the VLE should be identified. In addition, universities need to specify which one will be responsible for managing the teaching resources. The agreed responsibilities for course administration and management should be specified and included in the contract.

  In the evaluation survey the participants commented that universities should be concerned about who will manage the cloud resources. These responsibilities will depend on the model of cloud that the universities select (see Chapter 3). These challenges can be discussed and the agreement documented in the contract.

- **Promotion/marketing**

  Universities will face challenges in the promotion and marketing of the courses produced within the collaborative environment, so it is important that they verify the demand for a proposed course. They need to conduct market research to identify demand prior to course development (Hewson 2018). Collaborating universities should determine which of their number is responsible for conducting the market

research prior to development and also for the promotion of the course after development. This should be documented in the contract agreement.

- **Finance**

  Sharing costs between universities will make the development and delivery of the courses more financially viable. Therefore, a collaborative cost model would generally be included in the agreement. Partner universities need to determine and divide the proportion of the cost for each university prior to adopting the environment. Sharing of the costs of development and maintenance of teaching resources should be negotiated between the universities involved and included in the contract agreement.

  The tuition fee, and the strategy and process for increasing that fee, need to be discussed and agreed. In the evaluation survey, the evaluators commented that universities also need to share the cost of cloud services and VLE and agree on the proportion that will be payable by each university in the contract agreement.

6.2.5 EDUCATION

Education is the fifth main element and includes a number of associated issues. Education broadly relates to teaching, learning, assessment and the collaborative environment which supports them, as shown in Figure 6-6.

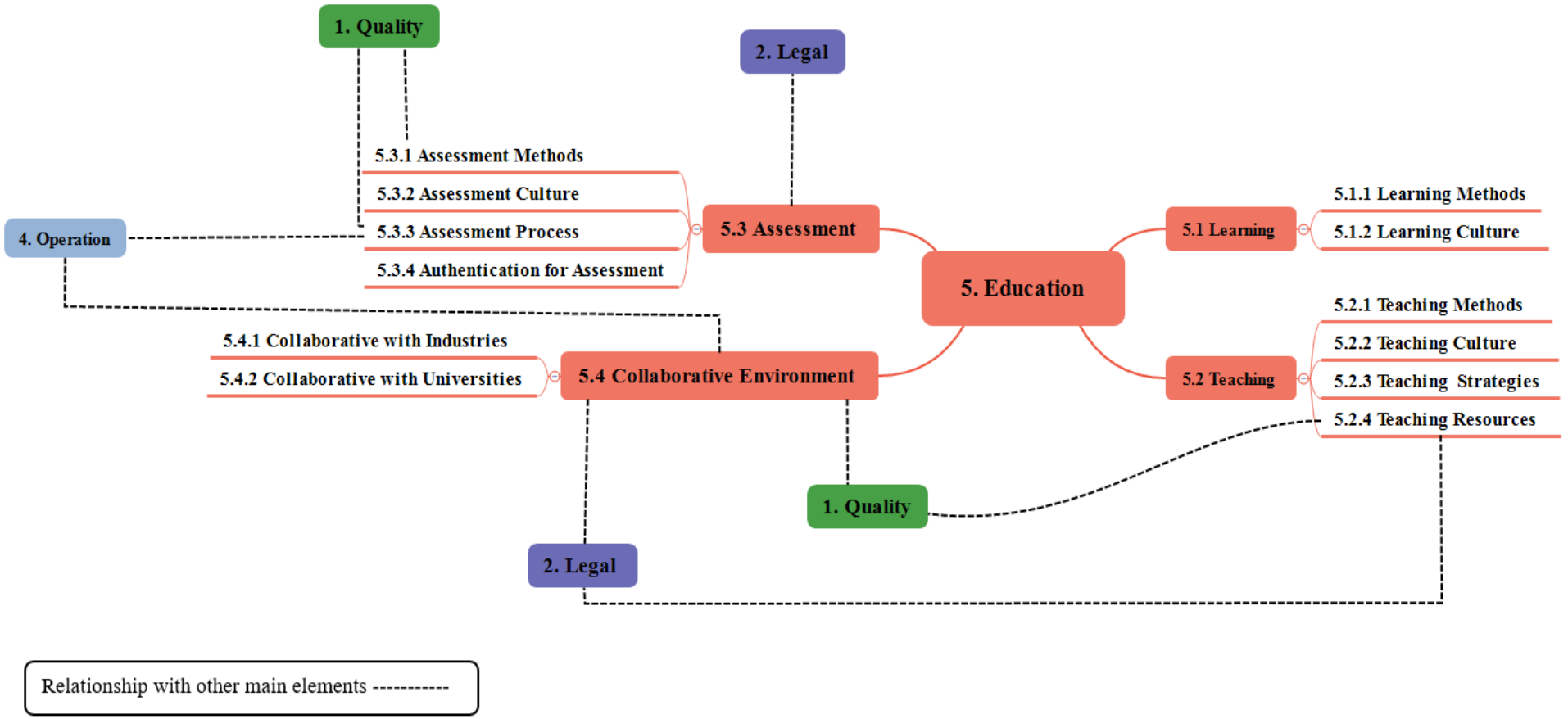


Figure 6-6: Education element

- **Learning**

  With respect to learning, students may face challenges associated with using resources developed jointly by different academics. These challenges may exist for students who are from a different culture and/or are not used to different learning methods. For example, students who have previously only had face-to-face classroom teaching/learning experiences may find it difficult to communicate with their peers and to share information in a collaborative environment. In the evaluation survey, the participants commented that the quality element should deal with aspects of learning. Universities need to ensure the quality of learning outcomes for all students because the learning outcomes of modules/units are highly important indicators of student achievement from their modules/units.

- **Teaching**

  In terms of teaching, academics may face challenges with respect to the sharing of teaching methods, teaching culture, strategies, and teaching resources. Universities should be responsible first for training staff to jointly develop teaching resources, and then how to share them. They are responsible for developing a sharing culture but may face another issue related to teaching culture, where academics are reluctant to share knowledge, experience and teaching materials with others.

  Another issue that should be taken into account before implementing the collaborative environment is that of teaching strategies. The teaching resources to be used should be considered by the partner universities. Ownership of the teaching materials needs to be specified and agreed. Quality of teaching resources is another crucial issue which should be monitored within the collaborative environment.

- **Assessment**

  Due to the nature of online courses, it is not possible to assess students in the same manner as those who are present on campus. Academics will face challenges concerning the need for assessment methods that ensure that students meet the expected learning outcomes. Academics must discuss and agree on the assessment process in the contract agreement. The assessment system or platform which will be used by the universities should be identified and agreed in the contract. Universities also need to apply an agreed security mechanism to secure access to the assignment

briefs and for submission of student work. They also need to discuss and agree the quality assurance process that will be used to ensure the academic standard for the assessment methods.

Within the shared environment, academic culture may affect joint online assessment. Universities need to agree on the assessment process, methods, and materials. They will face challenges with the authentication processing of online students and need to agree on which assessment systems and authentication methods they will use.

- **Collaborative environment**

The collaborative environment is one of the issues related to the education element. Collaboration could take place between universities and also between industries and universities. For both types of collaboration, universities should consider the issues related to finance, staff development, quality and culture. These should be negotiated between partners and agreed in the contract agreement.

In the evaluation survey, the participants stated that the sharing environment between universities needs to consider collaborative activities between students in relation to equality, diversity and inclusivity. These matters should be discussed and documented in the contract agreement.

6.3 SUMMARY

This chapter has discussed a proposed conceptual framework for a cloud-based collaborative environment between universities for online course provision. The framework has five main elements – quality, legal, security, operation and education – and illustrates the relationship between those elements. Each element includes sub-elements that should be considered by partner universities before adopting a collaborative environment, and each element is discussed, and the relationships between other elements is highlighted. The framework and the discussions form guidelines that outline to universities the issues that should be taken into account and tackled prior to adopting a cloud-based collaborative environment. The next chapter will discuss the prototype that was developed to test a section of the framework.

CHAPTER 7: THE PROTOTYPE

This chapter discusses the prototype that was developed to test part of the framework. Also explained in this chapter are the prototyping software development lifecycle and the design and implementation of the prototype.

7.1 THE PROTOTYPE

Due to the complexity and size of the framework, the prototype was developed to test only a part of it. The purpose of the prototype was to illustrate some of the concepts of the framework prior to establishing a collaborative environment for online course provision. The prototype was designed to help university partners to check compliance with the course development methodology/process and to avoid possible detrimental effects. The focus of the prototype was on course development, assessment processes, and creation of assessment materials.

The prototype also illustrates some of the guidance which should be made available to the partners. It shows the steps and processes that should be taken into consideration in a collaborative environment.

7.2 DESIGN AND IMPLEMENTATION OF THE PROTOTYPE

To design and develop the prototype, the Development Life Cycle (SDLC) model was used. The SDLC model includes different phases, from planning to testing and deployment, and describes how the software will be developed (Ragunath et al. 2010). The SDLC is used to supply a structure for software improvement, giving a framework for software development methods and tasks. This helps to split this increasingly difficult task into smaller subtasks that will assist, plan and monitor the work, support collaboration and interaction between the different people and groups involved, and ensure the quality of the result. The models are used to develop and automate parts of the development process which needed more detailed descriptions or models of the software processes involved (Kneuper 2017).

There are a number of types of SDLC model, including the waterfall model, prototyping model, spiral method and V-shaped model. To develop the prototype in this research, a prototyping software development lifecycle, which is a systematic approach to the development and delivery of software (Tuteja and Dubey 2012), was adopted. The prototyping SDLC has a number of features, for example, it can develop the quality of

requirements given to developers. It also requires user engagement and enables them to provide feedback to the developer (Tuteja and Dubey 2012), whilst risks can be detected at an early stage (Verma 2014). The prototyping SDLC model consists of a number of phases, beginning with the definition of requirements, as shown in Figure 7-1.

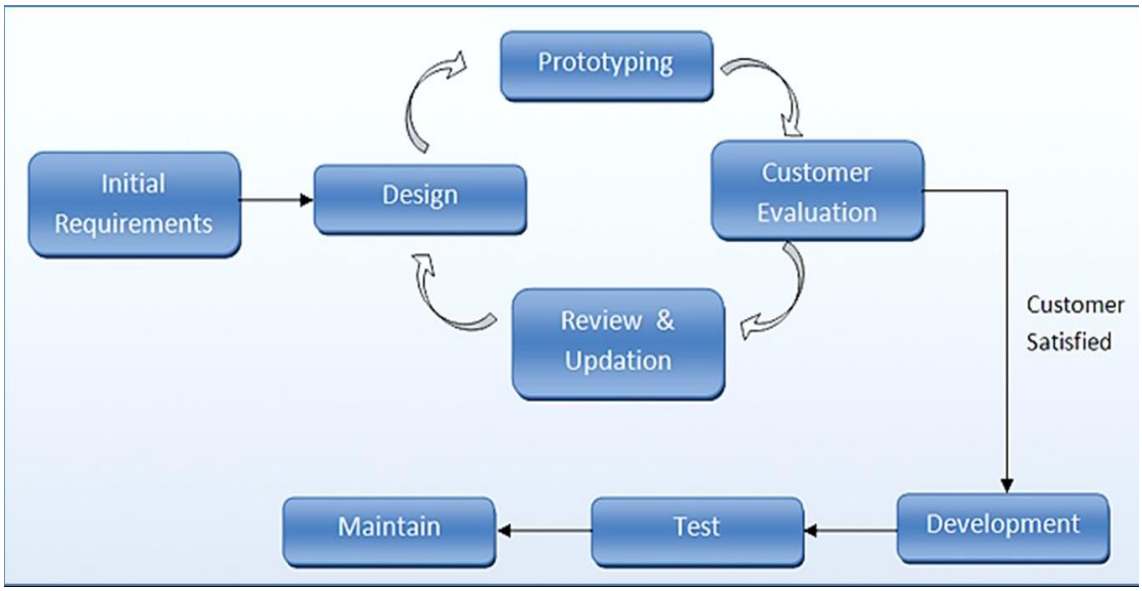


Figure 7-1: The prototyping SDLC model adapted from Arora and Arora (2016)

7.2.1 INITIAL REQUIREMENTS

Requirements analysis and definition to understand the overall concept of the proposal. Two types of user were considered for the prototype, namely administrators and users who were university staff involved in the collaboration. Users can select a course code from the course list and view the list of universities that are a part of the collaboration. In addition, the system should allow users to access documents that have been approved collaboratively and to view the details for each stage. Also, the system allows the user to view notification alert messages, which are sent when any of the course processes are updated. Furthermore, it allows users to download the agreed files between universities and other documentation.

Moreover, the prototype should allow administrators (users) from universities that are a part of the collaborative group to edit the status of any process. The system should send notifications to each member who is involved in the collaboration for a specific course. Administrators (users) can also be normal users of other courses and have the same rights as the rest of the team for that course.

The requirements were divided into functional and non-functional requirements. The non-functional requirements concentrate on usability and reliability. Usability refers to how easy the prototype is to use and how easy it is to access the materials. Reliability ensures that the prototype works without failure. The main focus of the prototype was on the functional requirements that are listed in Table 7-1.

User type	**Prototype functional requirements**
User	to view the process and status for each course
	to view the details of the process and status
	to download documents
	to receive and view notification alerts
Administrator	to view the process and status
	to update the status for each process

Table 7-1: Functional requirements of the prototype

Figure 7-2 shows the use cases for the prototype.

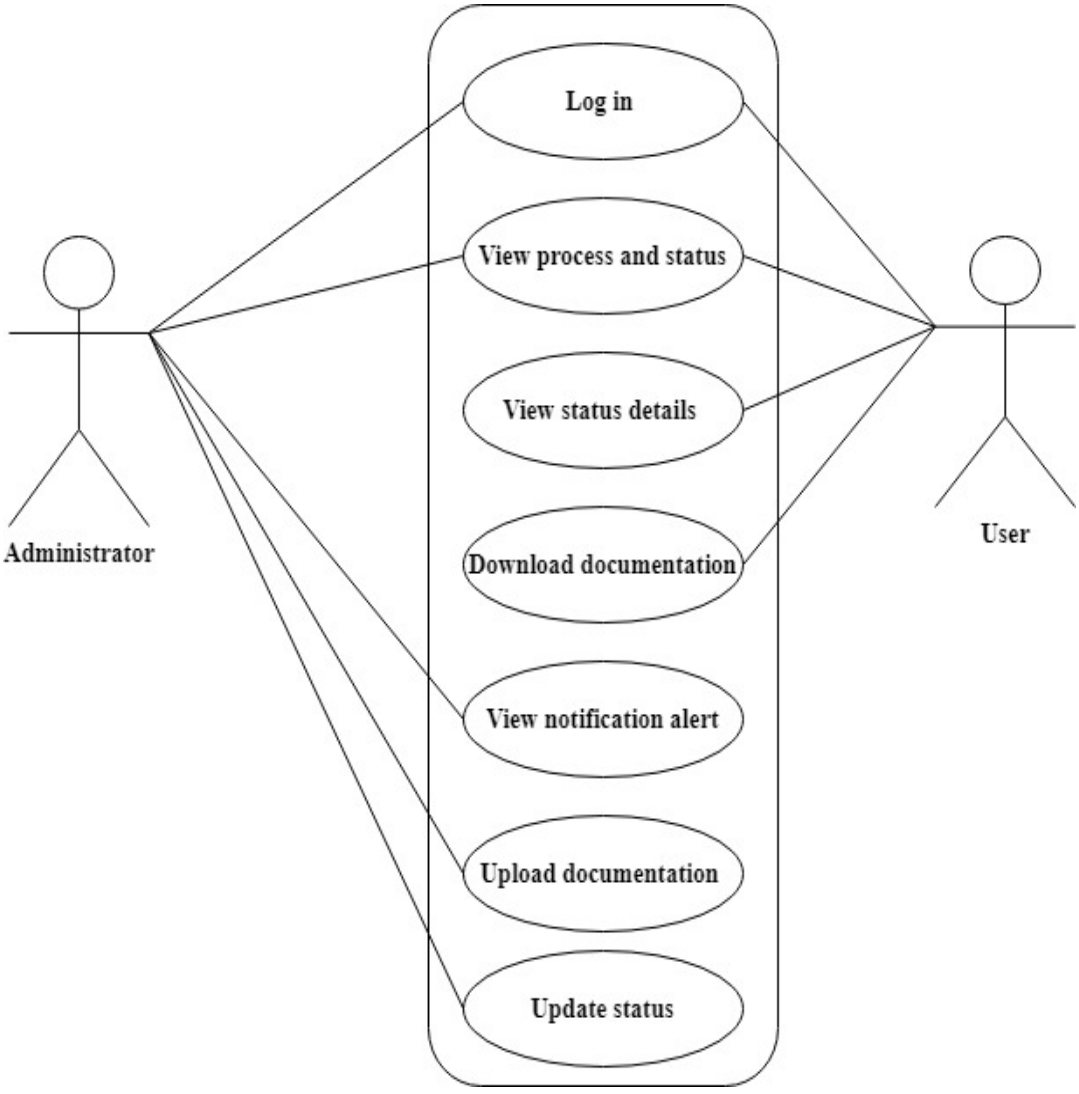


Figure 7-2: The prototype use cases

7.2.2 SOFTWARE DESIGN

The prototype was developed using the PHP programming (phpMyAdmin 2019) language and a MySQL database (MySQL 2019). PHP was chosen for its open source code which enables rapid code development. XAMP was downloaded and used to install Apache, containing MariaDB, and PHP (Apache Friends 2019). These were downloaded to a Windows 10, 64-bit operating system. The RAM space for hardware was 8.00 GB.

As mentioned above, the prototype focused on the assessment process, assessment development and course development, each of which is discussed in the flowcharts that follow.

1. Assessment process

The assessment process, as shown in Figure 7-3, was incorporated into the prototype. To begin with, the universities should discuss and decide on the assessment strategies to be adopted. They should then: discuss and agree upon the assessment process; identify and agree upon the assessment platform/system/VLE; prepare and agree upon the assessment methods to be used; agree upon the quality assurance process; agree on the methods for authentication of online assessment; and finally, they should begin to develop assessment materials.

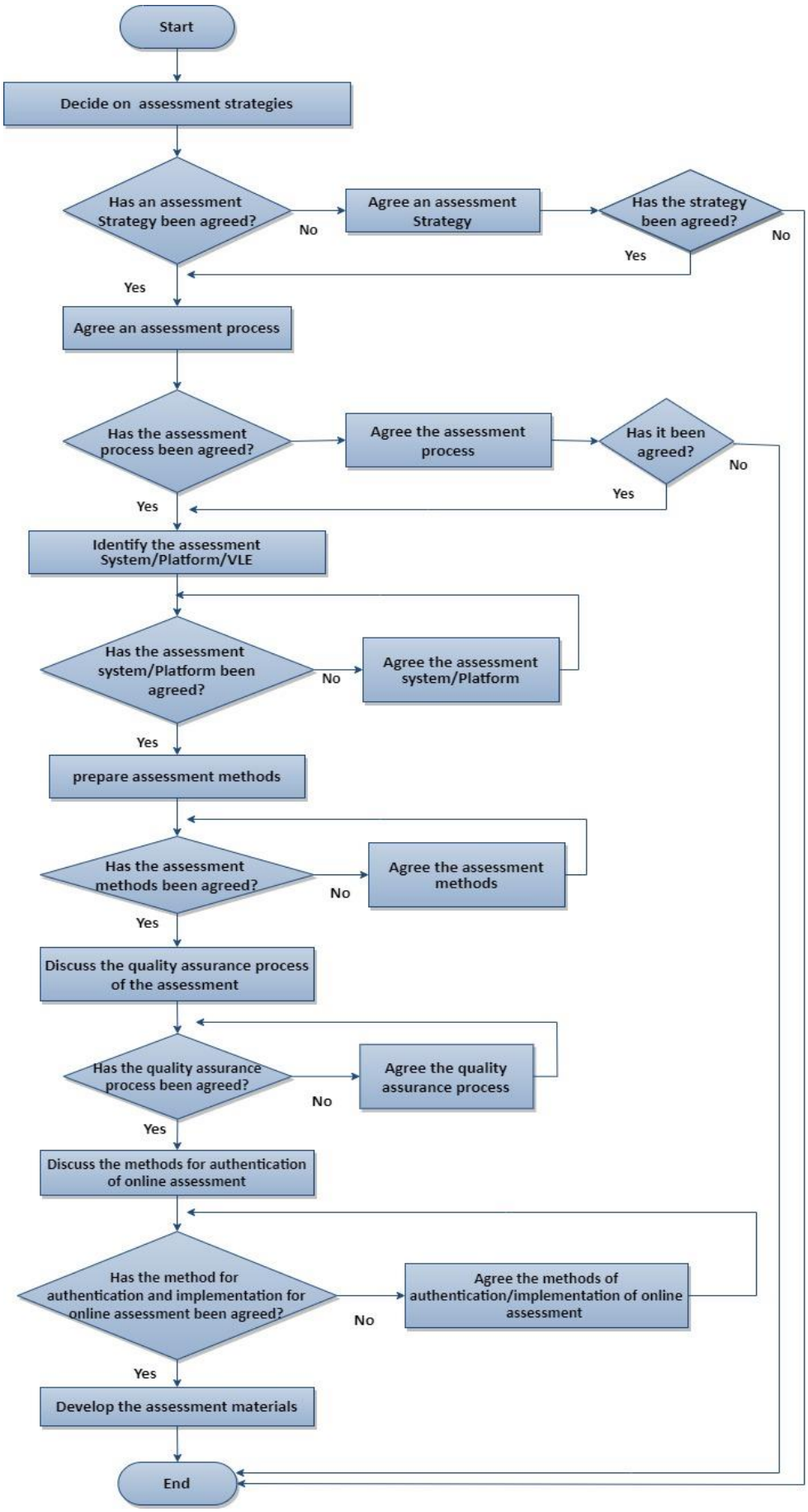


Figure 7-3: Assessment process

2. Development of the assessment materials process

It is expected that universities will identify a leader to coordinate the development of assessment materials. Also, the quality assurance process will need to be agreed upon and implemented. The assessment materials should then be ready to use. The process that should be followed to share the development of the assessment materials between universities is shown in Figure 7-4.

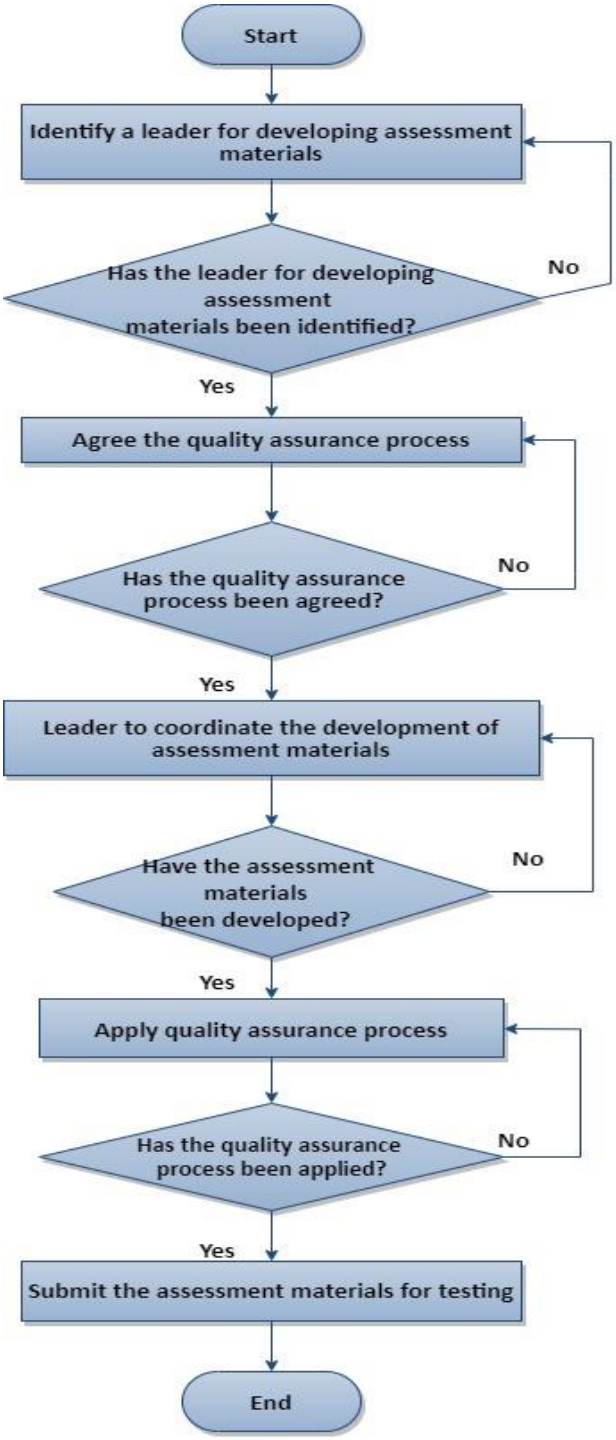


Figure 7-4: Process that should be followed to share the development of assessment materials

3. Course development process

It is expected that universities will conduct market research to explore whether there is a demand for a particular course before moving to the development stage. In this process, a university must be identified to lead this activity. Also, a cost model should be agreed by the collaborative partners. The flowchart in Figure 7-5 shows the processes for sharing course development.

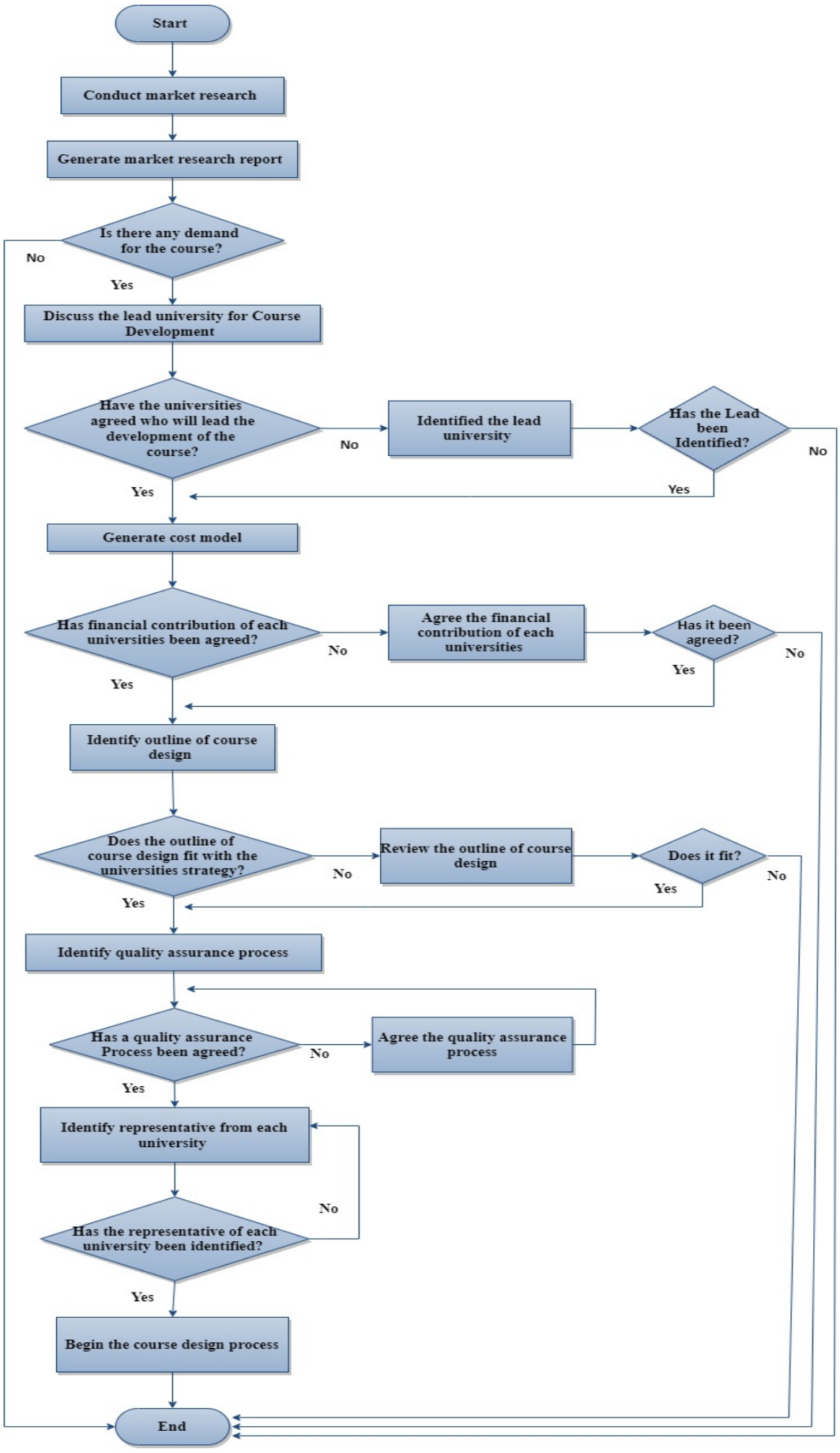


Figure 7-5: Course development process

- ***Viewing the stages and status (collaborative partner)***

The prototype allows users and administrators to log in. Collaborative courses can be selected, which will be associated with the universities involved in the collaboration. Thus, the prototype directs users to the collaborative partners' page which shows a list of universities involved with each course. Also, the page indicates the final status for the completion stages of each university with regard to the course development, assessment process, and development of assessment materials, as shown in Figure 7-6. The yellow buttons show the stages that have not been completely agreed, whereas green buttons indicate those that are completely agreed.

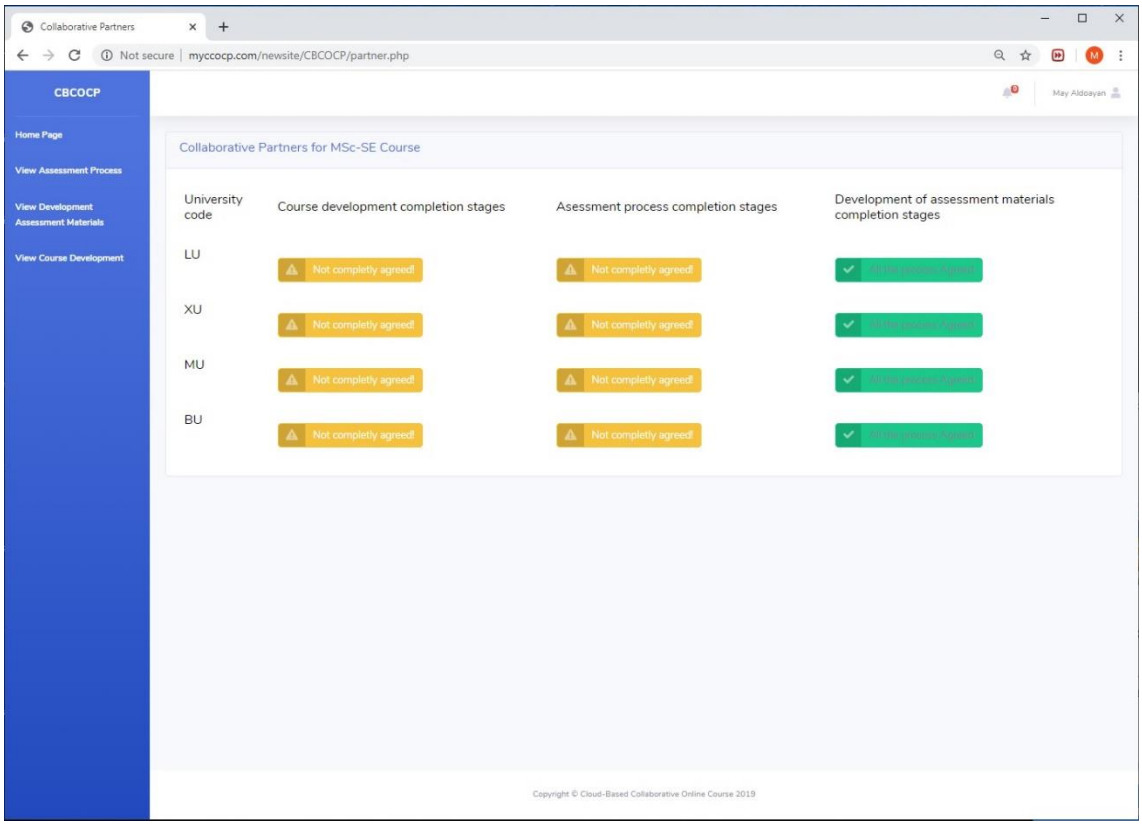


Figure 7-6: View Collaborative universities for specific course

The user can press the yellow buttons to see the status in detail for each stage, as shown in Figure 7-7. If the button is green, it means that all the stages are completely agreed, so there is no need to explore further.

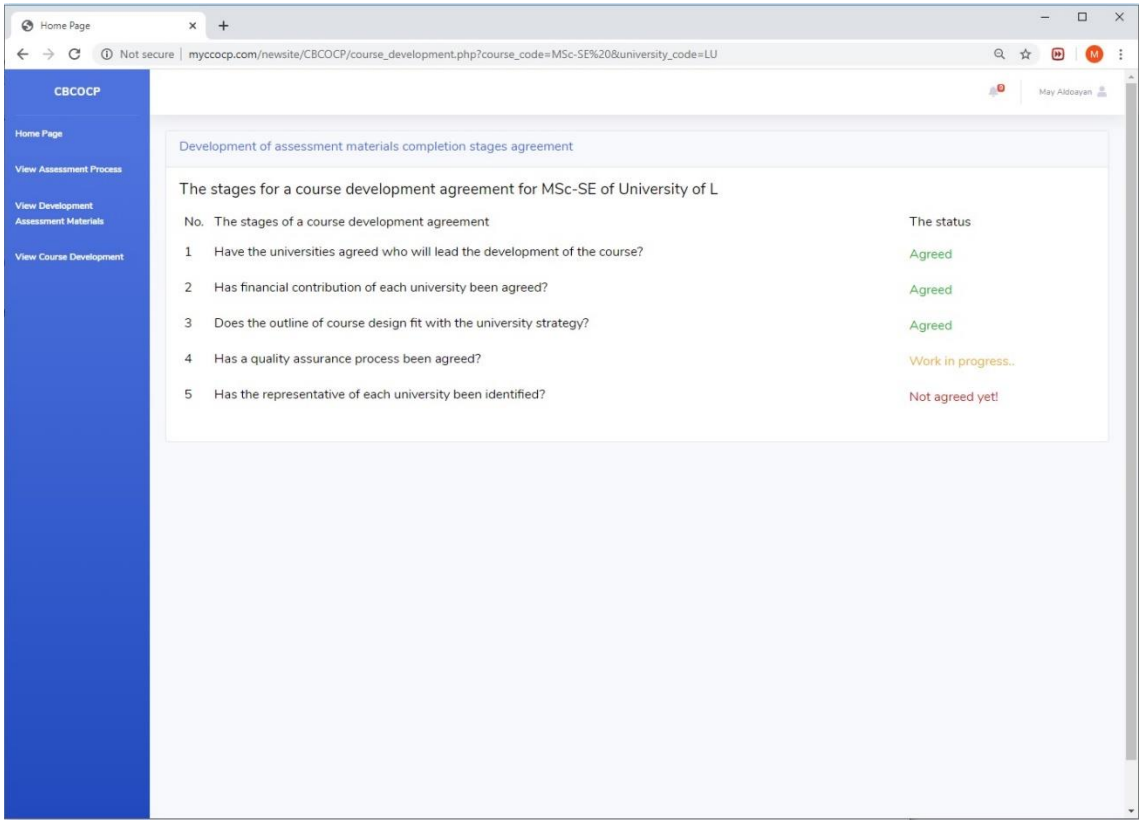


Figure 7-7: Viewing the process and status for the development of assessment materials

- ***Viewing details at each stage***

If the user is a member associated with a course, they can select 'View Details' from the vertical navigation bar on the left-hand side of the page for more information about the stages in the assessment processes, development of assessment materials or course development. In this case, information about the stage name as well as status, the date and time, and agreed documentation will be displayed, as shown in Figure 7-8.

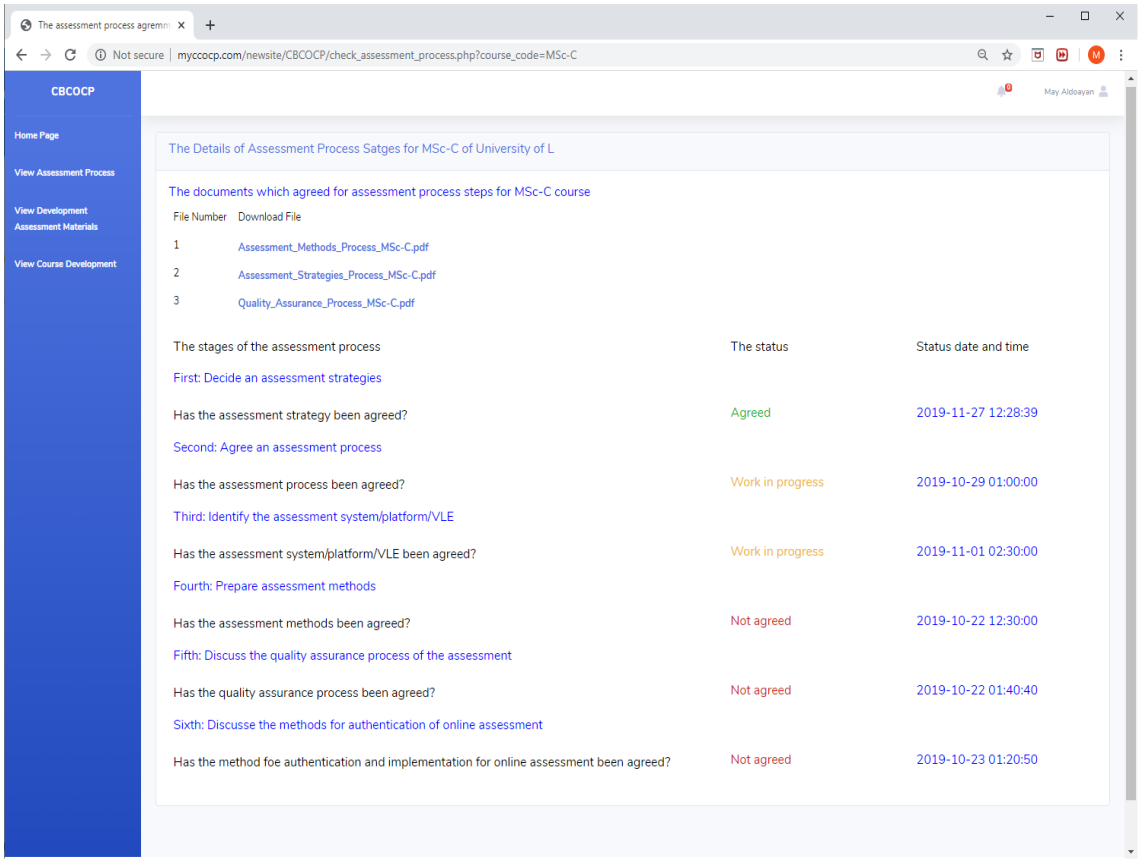


Figure 7-8: Details of assessment process completion stages and status

- ***Editing the status***

If the user is an administrator, the 'edit' option will be enabled in the navigation bar on the left-hand side that will permit the status of the assessment processes, development of assessment materials and course development to be changed. The administrator has the right to modify the status of the courses and upload the documentation to each specific folder. For example, changing the status for each stage from 'not agreed' to 'work in progress' or 'agreed', and from 'work in progress' to 'not agreed' or 'agreed'. The system will be updated, and the date and time for each updated status are added automatically, as shown in Figure 58. The prototype will send a notification alert to each user in the universities collaborating on a specific course. Figure 7-9 shows the administration page for editing assessment processes for a course, and the collaborative universities involved.

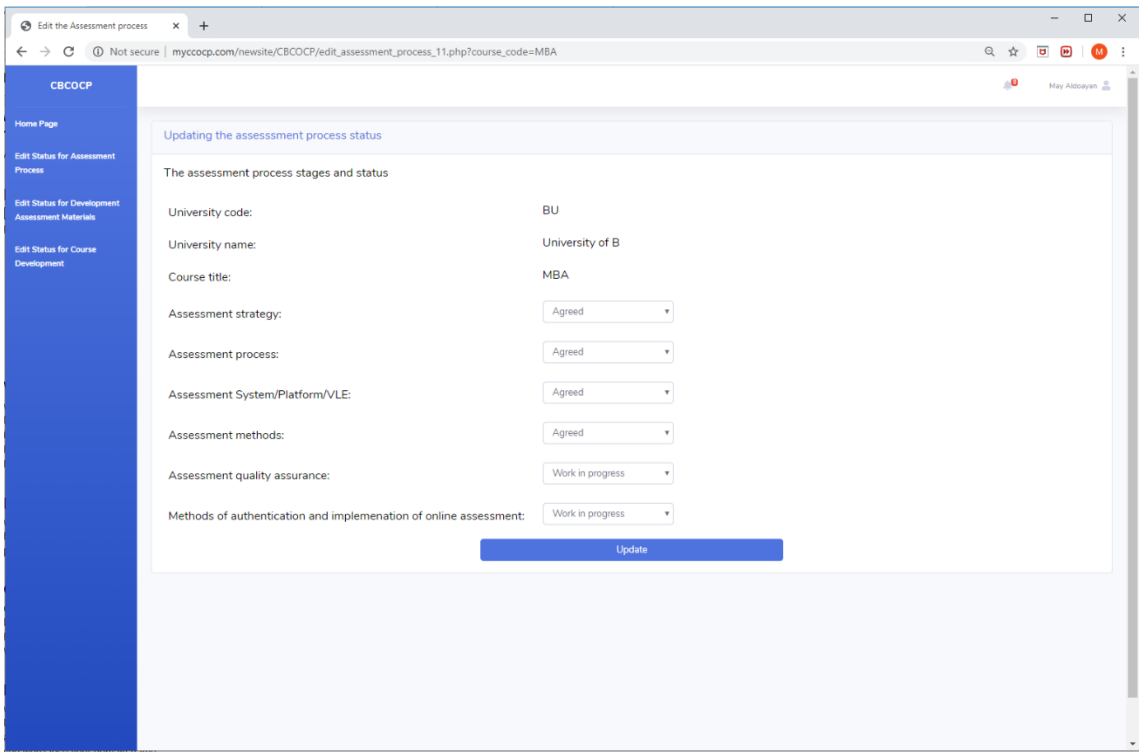


Figure 7-9: Editing page available to the administrator for the assessment process

7.2.4 SYSTEM EVALUATION

The functionality of the prototype was tested by three academics to ensure that the requirements had been met, then the PHP pages and MySQL database were moved to a Bluehost (Bluehost 2019) hosting website to enable practitioners to evaluate it. A questionnaire was used in this evaluation process (see Chapter 8 for details). Twenty-one participants completed the questionnaire to assess the functionality, process and usability of the prototype. The participants' feedback and suggestions were reviewed and used to improve the hosted prototype.

7.3 SUMMARY

This chapter has discussed a proposed prototype for testing a small part of the conceptual framework for a cloud-based collaborative environment for online course provision. The prototype could be used to guide the universities to check compliance with the process and to avoid detrimental effects. This chapter discussed the design and implementation of the prototype. The next chapter presents the evaluation of the conceptual framework and of the prototype.

CHAPTER 8: EVALUATION OF THE CONCEPTUAL FRAMEWORK AND PROTOTYPE

This chapter focuses on the evaluation of the proposed conceptual framework for a cloud-based environment and its prototype. Two survey questionnaires were developed to collect participants' views about the framework and the prototype. This chapter presents the result of the analysis of those surveys.

8.1 EVALUATION OF THE CONCEPTUAL FRAMEWORK

The proposed framework was evaluated by a group of academics who had experience with online courses. The participants provided their views on the elements of the framework and the issues related to each element. In addition, they gave their views about the relationships between the elements.

A survey questionnaire was used to evaluate the framework. Non-random sampling (McMillan 1996) was chosen for the evaluation survey. The participants were twenty-seven practitioners within two category groups:

- One group provided expertise from the perspective of using the technology to deliver online courses: they were heads of educational technology or senior academics from the education department who had expertise in online courses.

- The other group provided expertise from the perspective of the technology used: they were senior academics from computer science education who had expertise in online courses.

The evaluation aimed to determine the degree to which the framework accurately represented a collaborative environment between universities prior to adoption. In particular, it aimed to validate:

1) The overall structure of the framework for a cloud-based collaborative environment for online courses.

2) The overall appropriateness of the structure of the grouped elements and sub-elements within the framework for a cloud-based collaborative environment for online courses.

3) The relevance and comprehensiveness of the issues considered that are associated with each element within the framework

4) The appropriateness of the relationships between the five main elements within the framework.

The evaluation is based on the practitioners' feedback and comments with regard to how well the framework meets these four criteria.

8.1.1 CONCEPTUAL FRAMEWORK EVALUATION PROCESS

A questionnaire-based survey was developed to enable participants to validate the proposed framework. The participants were presented with the information about the framework in the form of a set of figures that represented the structure of the elements in the overall framework with separate figures for each of the elements to provide more detail. The questionnaire had two sections. The first section covered the role of participants. The second covered the framework and its elements. Participants were required to give their opinion about the framework and the elements by responding to nineteen questions. Thirteen Likert-type scale questions and six open-ended questions were used. The open-ended questions enabled the participants to add more comments about the relationship, associated issues and the framework structure.

The survey was conducted using the 'SmartSurvey' website (SmartSurvey 2019), and was piloted by three academics to identify any possible errors in the questions, structure and formatting of the questionnaire. Some comments were received about the accuracy of the figures, and the questionnaire was corrected accordingly.

Invitation emails were sent to the academic participants encouraging them to participate in the evaluation. A number of confirmations of completion emails, automatically sent by the questionnaire website, were received. The online questionnaire was accessible for four months. All data and information obtained from the participants were anonymised and recorded.

8.1.2 FRAMEWORK SURVEY ANALYSIS AND RESULTS

The results of the survey were analysed using SPSS version 26 (IBM SPSS Software 2020), and the reliability test was carried out using Cronbach's Alpha, as shown in Table 8-1. According to Sekaran and Bougie (2016), reliability figures of over 0.80 are

considered to be good, so the test result of 0.953 in this case means that the reliability of the data obtained from this survey is good.

Table 8-1: Cronbach's Alpha test – Framework survey

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardised Items	N of Items
.953	.951	13

The academics who participated in the evaluation were five heads of educational technology department, one educational/learning developer, and twenty-one senior academics from computer science and education departments; twenty-seven in total. Figure 8-1 shows the roles of the participants.

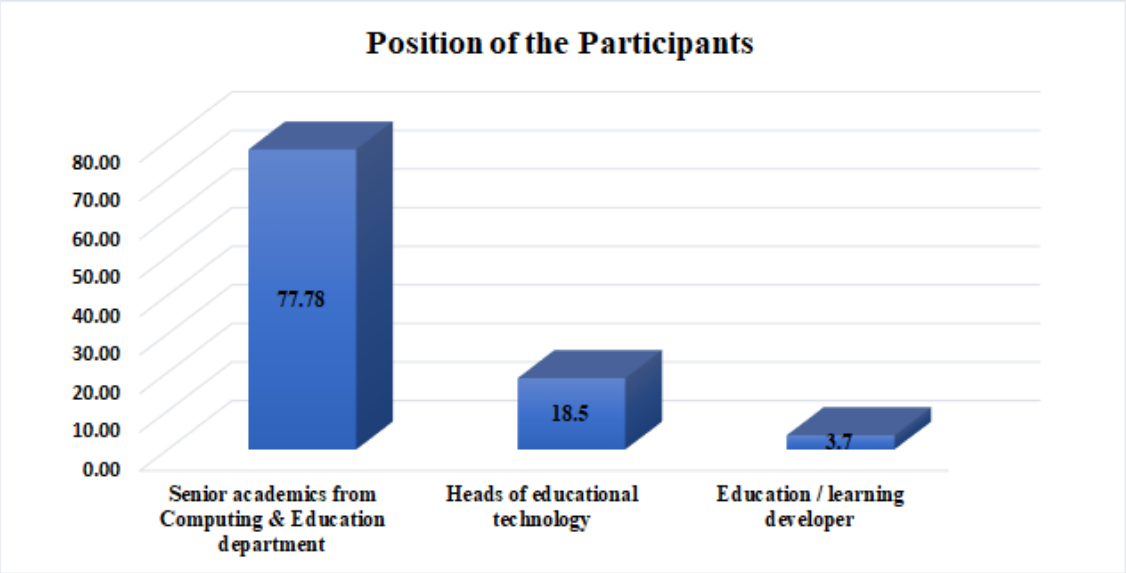


Figure 8-1: Number of the participants based on position

8.1.2.1 STRUCTURE OF FRAMEWORK AND RELEVANCE OF THE MAIN ELEMENTS

Descriptive statistical analysis was used to summarise the results for each question which were received independently from each of the participants. Medians were used to indicate common points between the views of the participants. The data used is ordinal therefore, median values are the most suitable for this type of data (Manikandan 2011). Table 8-2 shows the rates and the median of the participant responses gathered using a five point Likert scale (1 = Strongly Agree, 2 = Agree, 3 = Neither Agree nor Disagree, 4 = Disagree, 5 = Strongly Disagree) concerning the framework.

Figure 8-2 shows the framework for a cloud-based collaborative environment for online course provision before the evaluation.

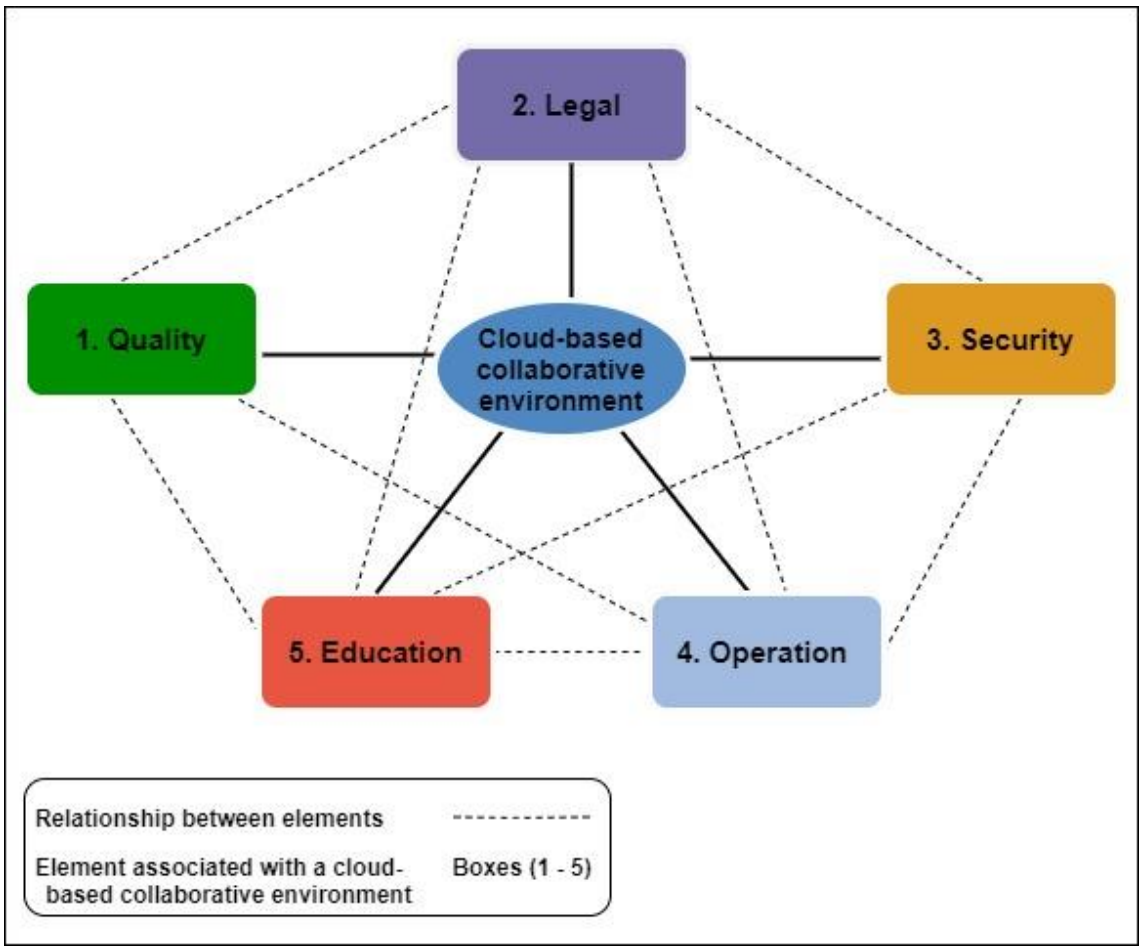


Figure 8-2: The conceptual framework for the cloud-based collaborative environment

Table 8-2: Framework structure statements – participant frequency responses

No	Questions	Median	1: Strongly Agree	2: Agree	3: Neither Agree nor Disagree	4: Disagree	5: Strongly Disagree
1	The structure of the framework is appropriate	2	N = 2	N=14	N=9	N=2	N=0
2	The main elements chosen for a cloud-based collaborative environment for online courses are relevant and appropriate	2	N = 3	N=15	N=8	N=1	N=0

It is clear that sixty percent of the participants agreed or strongly agreed that the structure of the framework was appropriate. However, 33% answered “neither agree nor disagree” to the question and commented that they needed more information about each element. In addition, 67% of participants agreed or strongly agreed that the main elements chosen

for a cloud-based collaborative environment for online course provision were relevant and appropriate. Thirty percent answered "neither agree nor disagree" to the question. Figures 8-3 and 8-4 are bar charts representing the frequency of selection of each of the Likert scale response categories for the two questions.

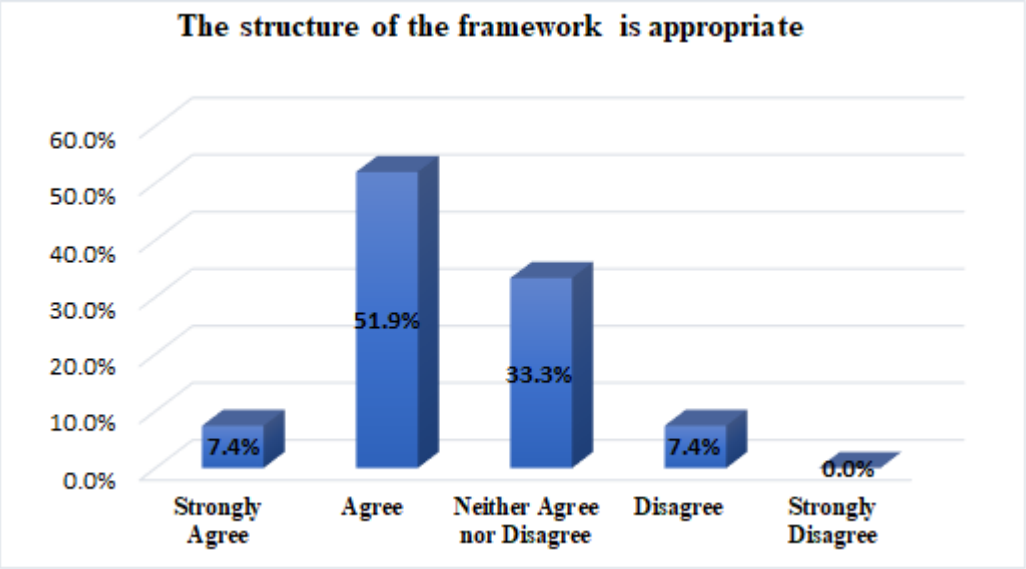


Figure 8-3: Participant responses to the appropriateness of the framework structure

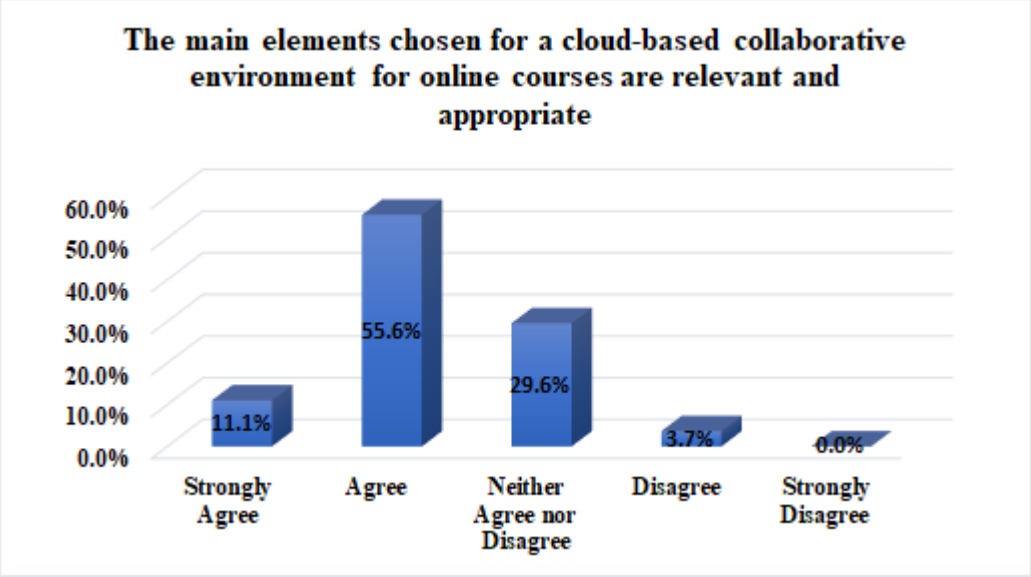


Figure 8-4: Participant responses with regard to the relevance and appropriateness of the main elements of the framework

Question three asked for further comments about the framework, and the two of participants suggested that it should link security with quality because there is a relationship between them; the quality can be enhanced if systems are well secured.

8.1.2.2 QUALITY ELEMENT

Figure 8-5 shows issues associated with the quality element and the relationships with other elements.

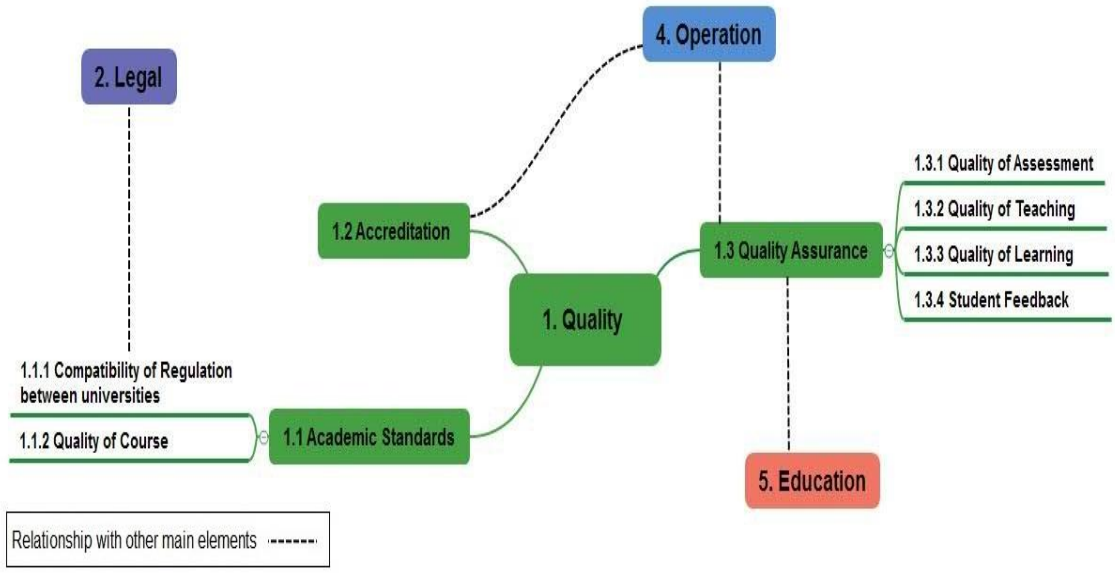


Figure 8-5: The quality element and its association with other elements

Table 8-3 shows a question about the appropriateness of the quality assurance process. It also includes an open-ended question, the results of which are illustrated in Figure 63. This provided an opportunity for the participants to comment on issues associated with the quality element

Table 8-3: The quality assurance process – participant frequency responses

No	Questions	Median	1: Strongly Agree	2: Agree	3: Neither Agree nor Disagree	4: Disagree	5: Strongly Disagree
4	The quality assurance process is appropriately addressed	2	N = 8	N=11	N=7	N=0	N=1

From Table 8-3, 70% of participants agreed or strongly agreed that the quality assurance process was appropriately addressed. Twenty-six percent answered “neither agree nor disagree” to the question. Figure 8-6 shows the frequency of selection of each of the Likert scale response categories for the question.

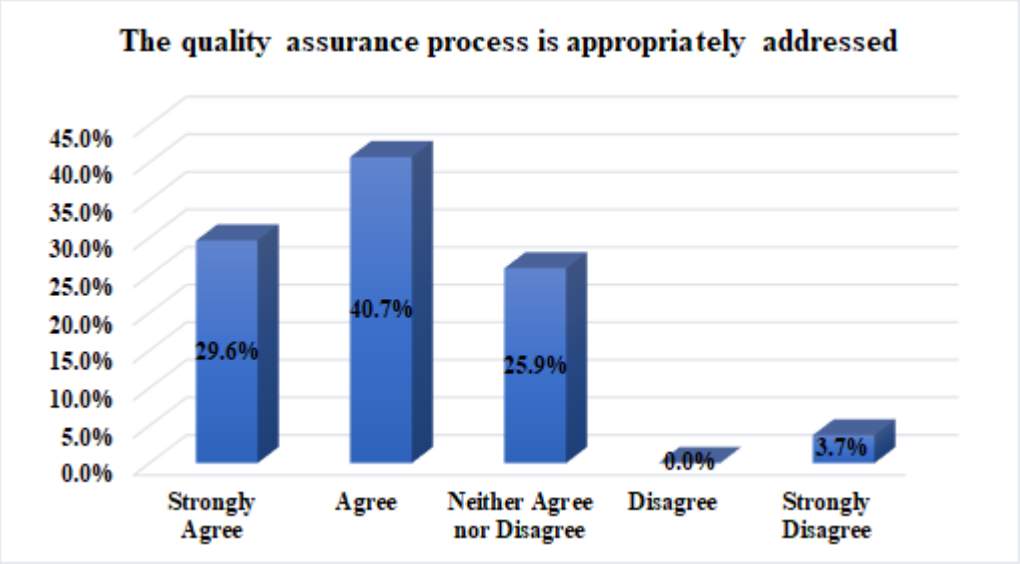


Figure 8-6: Participant responses concerning the appropriateness of addressing the quality assurance process

Question 5 asked for further comments about quality, and two of the participants indicated that the quality element should also include technology as a fourth sub-element. Furthermore, one of the participants commented that quality assurance should take into account staff feedback to students. They also stated that the quality assurance process should include other stakeholder interests, including those of employers, industry and alumni. Another participant commented that the quality assurance process includes the overall institutional evaluation process, which consists of all stakeholder, employer and industry surveys. They stated that the quality element should be directly related to the education element as all the sub-elements of quality contribute to education. These comments are discussed in Section 6.2.1 of Chapter 6 and illustrated in Figure 6-2.

8.1.2.3 LEGAL ELEMENT

Figure 8-7 shows the issues associated with the legal element and relationships with other elements.

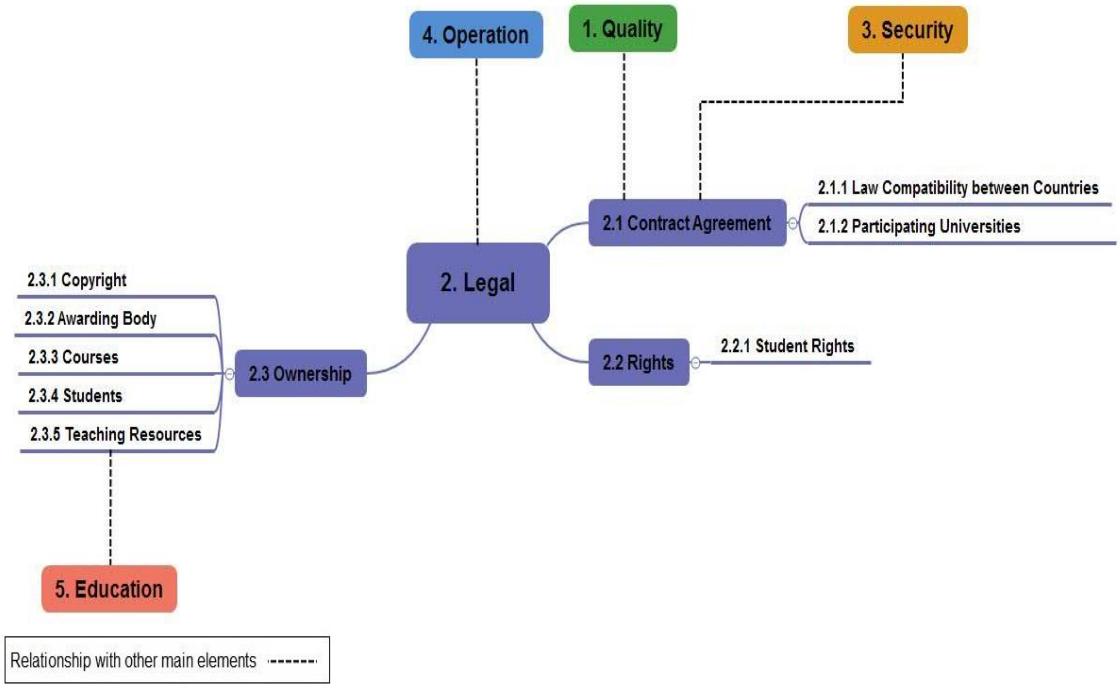


Figure 8-7: Legal element and associated sub-elements

Table 8-4 presents two questions, one of which relates to the evaluation of Figure 8-7, the other about issues related to ownership. This section also included an open-ended question.

Table 8-4: Legal element – participant responses

No	Questions	Median	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
6	The legal and related issues are sufficiently covered	2	N = 3	N=13	N=7	N=4	N=0
7	The framework clearly illustrates how ownership can be protected	2	N=2	N=13	N=7	N=4	N=1

As shown in Table 8-4, more than half of the participants strongly agreed or agreed that the legal element and related issues are sufficiently covered. This indicates that most of the legal issues that are important to academics have been considered in the framework. However, 26% answered “neither agree nor disagree” to the question. In addition, more than half strongly agreed or agreed that the framework clearly illustrates how ownership can be protected, while 26% answered “neither agree nor disagree” to that question. Figures 8-8 and 8-9 show the outcome for the two questions.

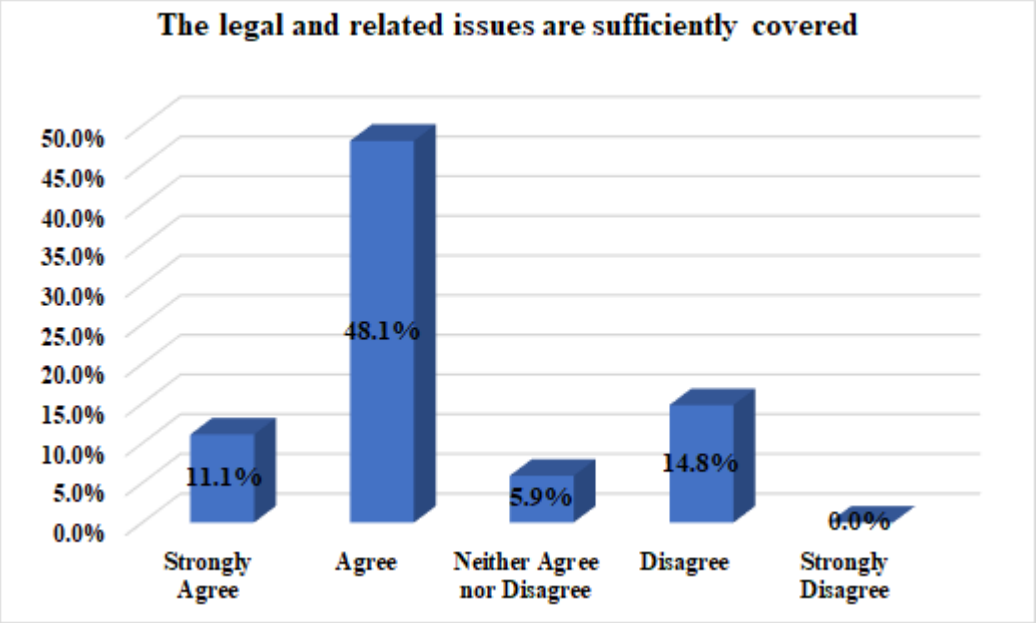


Figure 8-8: Participant responses regarding coverage of issues related to the legal element

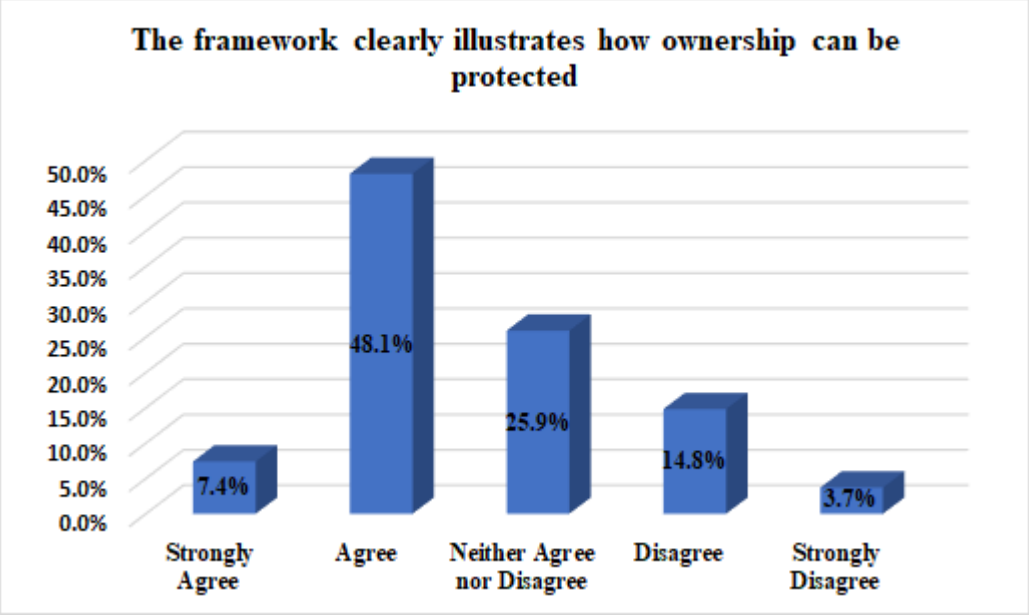


Figure 8-9: Participant responses regarding ownership protection

Question 8 asked for further comments and the participants suggested that: a) some issues associated with the legal element were missing; b) issues connected with General Data Protection Regulation (GDPR) that are related to contract agreements should be considered within the legal element; c) universities should consider the cloud provider and include it in the contract agreement; d) Completion and Markets Authority (CMA) rules should be considered and agreed in the contract agreement between course providers and students; and e) collaborating institutions should also be included in the contract agreement.

In terms of rights, the participants stated that staff rights should be taken into account and universities should recognise the rights of staff to retain certain elements of Intellectual Property (IP).

In addition, respondents felt that ownership of data was missing from the framework and needed to be considered. Finally, respondents suggested that ethical issues should be considered as sub-element. This and the above comments were incorporated into Section 6.2.2.

8.1.2.4 SECURITY ELEMENT

Figure 8-10 shows the issues associated with the security element and the relationships with other elements.

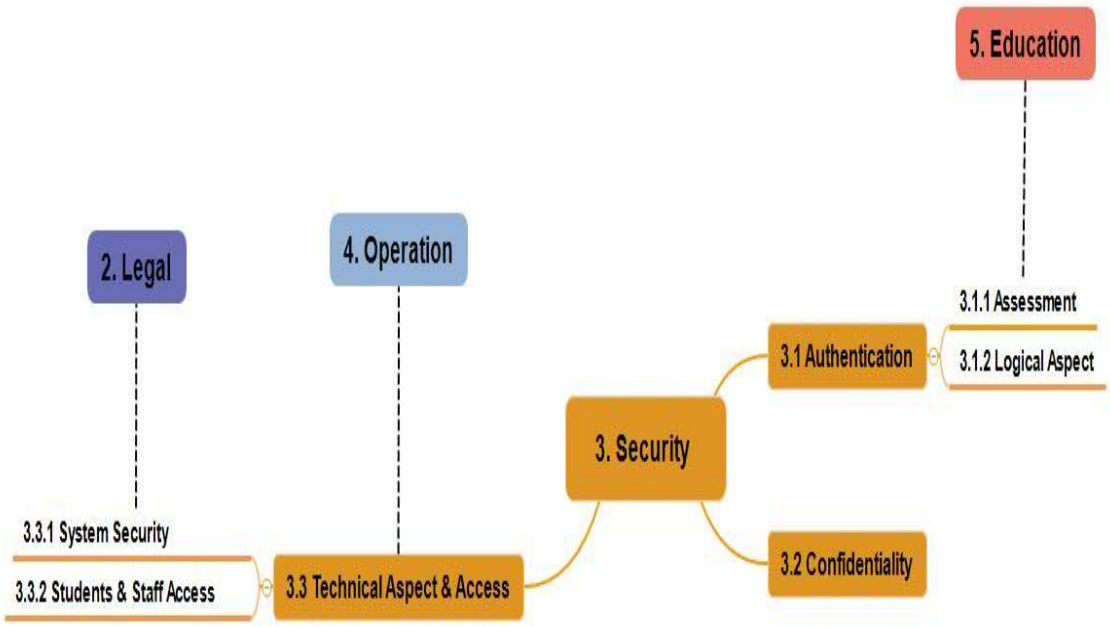


Figure 8-10: Security element and associated sub-elements

Table 8-5 presents two questions that were asked to evaluate Figure 8-10. One asks about the issues associated with security and authentication for accessing materials. The other is about the issues related to the security of online assessment and authentication. They were followed by an open-ended question which allowed participants to give their general comments.

Table 8-5: Security element – participant responses

No	Questions	Median	1: Strongly Agree	2: Agree	3: Neither Agree nor Disagree	4: Disagree	5: Strongly Disagree
9	The security and authentication for accessing materials are appropriately addressed	2	N =5	N=13	N=5	N=3	N=1
10	The security and authentication for online assessments are sufficiently addressed	2	N = 3	N=14	N=6	N=3	N=1

From the results shown in Table 8-5, 67% of the participants strongly agreed or agreed that the security and authentication for accessing materials were appropriately addressed in the security element. Nearly 19% selected "neither agree nor disagree" to the question as and then said that they lacked the necessary technical expertise to comment. Furthermore, 63% of participants strongly agreed or agreed that the security authentication for online assessments was sufficiently addressed. Nearly 22% answered "neither agree nor disagree". Figures 8-11 and 8-12 show the responses to the two questions.

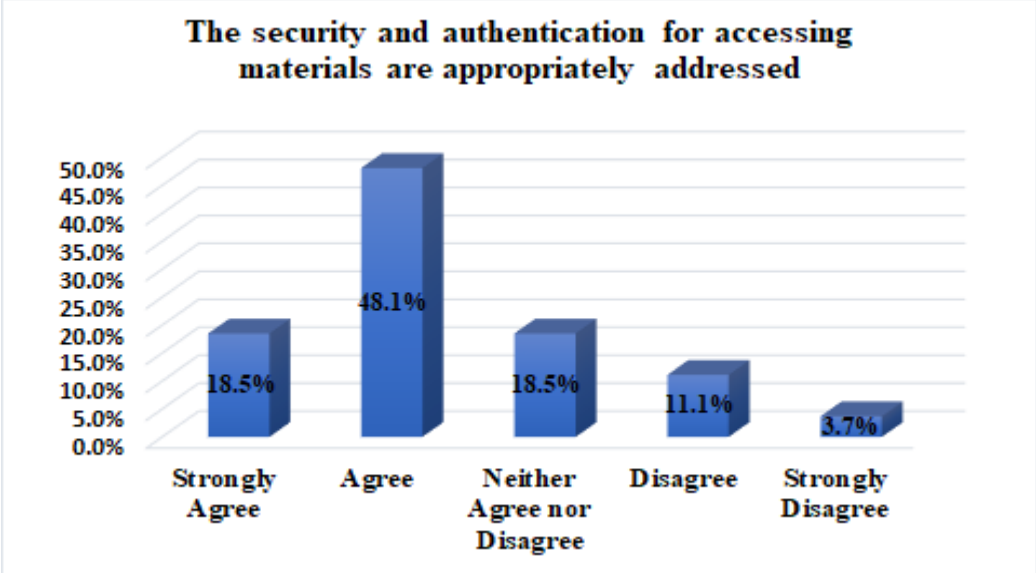


Figure 8-11: Participant responses concerning security and authentication for accessing materials

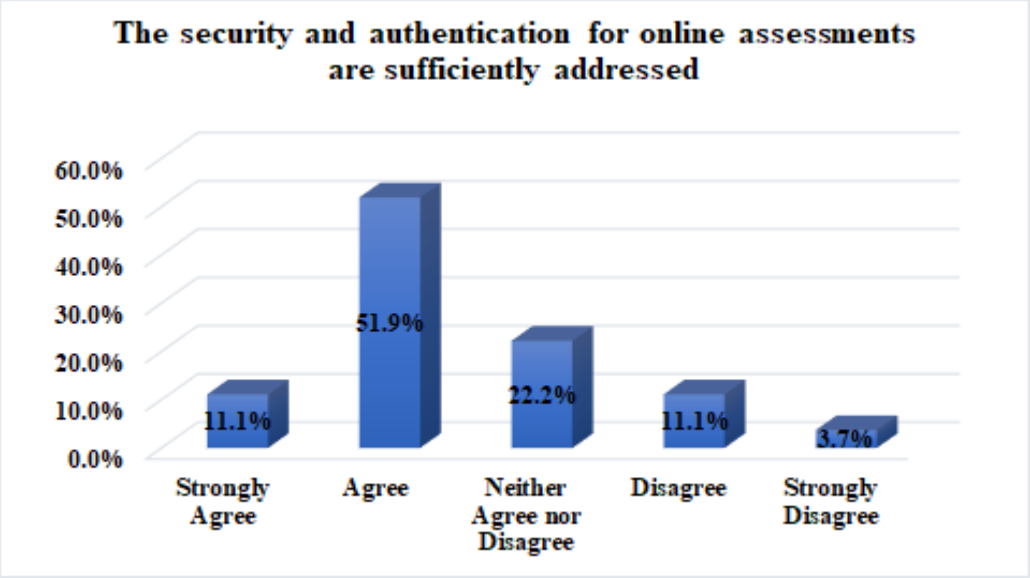


Figure 8-12: Participant responses concerning security and authentication for online assessment

In response to question 11, which asked for further comments, participants suggested that integrity was an important aspect of the security element that needed to be considered, that the logging onto the VLE should be added to the technical and access considerations, and that plagiarism checkers should also be considered for use as third-party tools.

The participants commented that there is a relationship between confidentiality issues and assessment in the education element. For example, the network should be secure enough to enable confidential marking, for example, blind marking and peer reviews, for summative assessments. Furthermore, there is a relationship between the technical aspect and access and the education element. Course curricula should be designed for online learning with an appreciation of the technical dependencies of an environment. Further, the participants commented that universities need to consider giving visitor access. The comments were incorporated into Section 6.2.3.

8.1.2.5 OPERATION ELEMENT

Figure 8-13 shows issues associated with the operation element and the relationships with other elements.

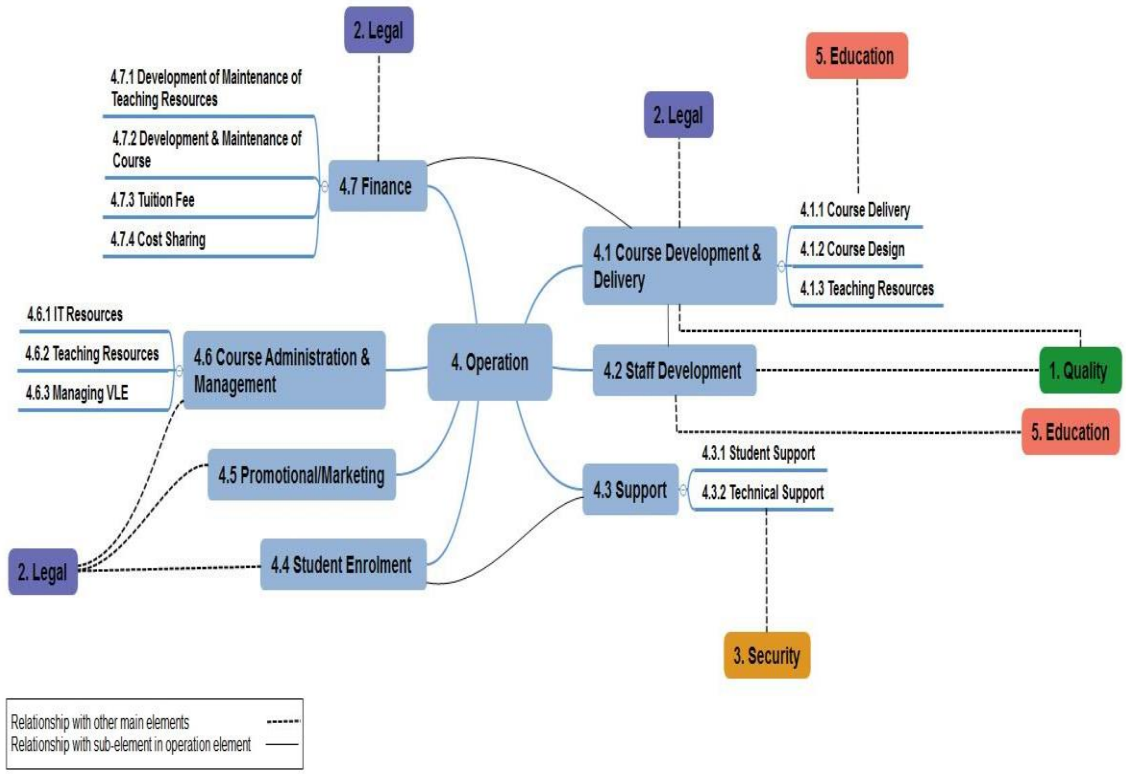


Figure 8-13: The operation element and its association with other elements and sub-elements

Table 8-6 shows three questions that were used to evaluate Figure 8-13. One relates to the issues associated with operation. The second relates to the consideration of the quality assurance process in relation to course development and delivery. The third question is associated with the consideration of related financial issues. These were followed in the questionnaire by an open question.

Table 8-6: Issues related to the operation element - participants responses

No	Questions	Median	1: Strongly Agree	2: Agree	3: Neither Agree nor Disagree	4: Disagree	5: Strongly Disagree
12	The operational issues are appropriately considered	2	N =6	N=14	N=4	N=2	N=1
13	The quality assurance process relating to course development and delivery is sufficiently considered	2	N =7	N=10	N=5	N=4	N=1
14	The financial related issues are sufficiently considered	2	N=7	N=11	N=4	N=4	N=1

Table 8-6 shows that 72% of participants agreed or strongly agreed that the operational issues are appropriately considered. Nearly 15% selected “neither agree nor disagree”. In

addition, 63% of participants agreed or strongly agreed that the quality assurance process relating to course development and delivery was sufficiently considered. Nearly 18% responded “neither agree nor disagree”. Further, 63% of participants agreed or strongly agreed that the related financial issues were adequately considered. Nearly 15% answered “neither agree nor disagree”. These results highlighted that the participant opinions of the operational issues considered by the framework were very positive. Figures 8-14, 8-15 and 8-16 are bar charts representing the frequency of selection of each of the Likert scale responses for the three questions.

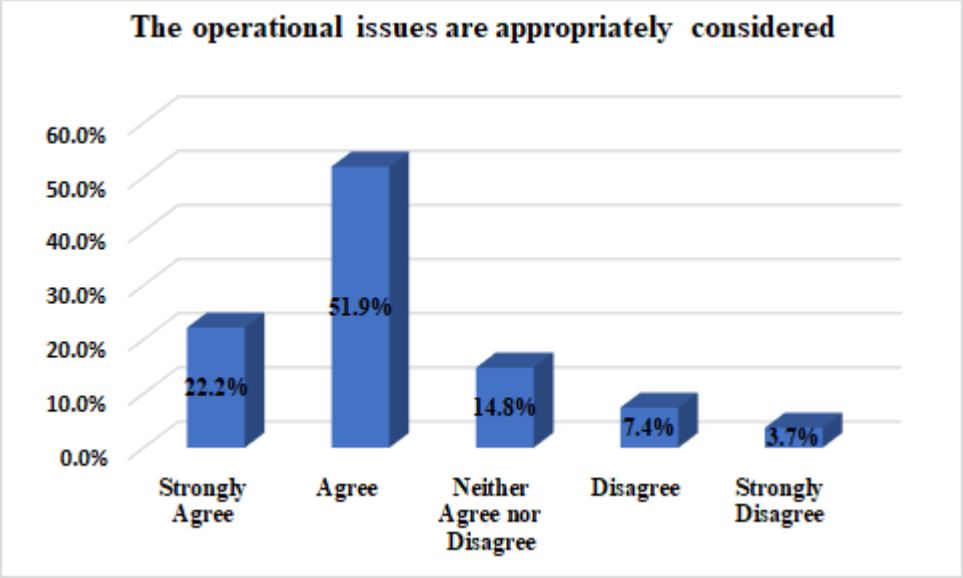


Figure 8-14: Participant responses in relation to the operational issues

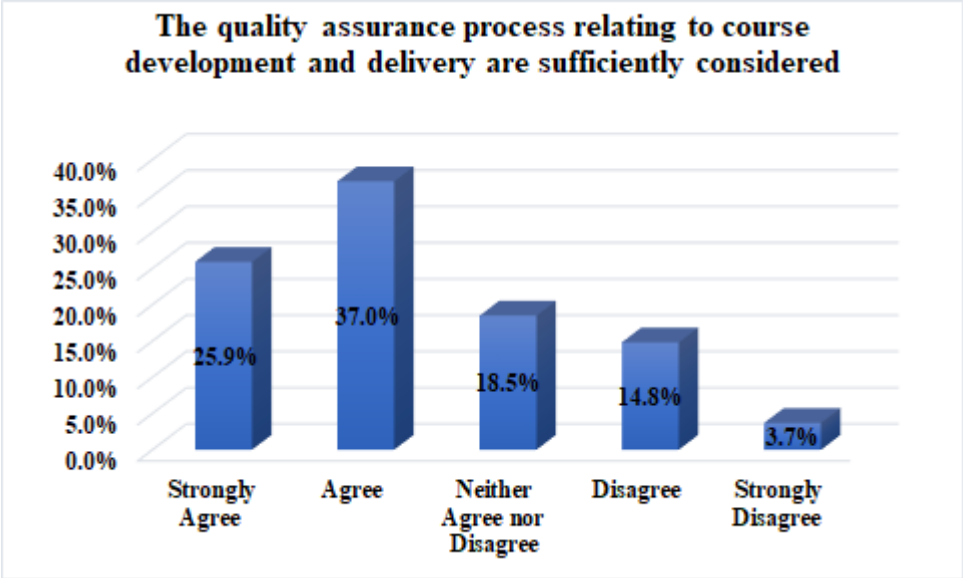


Figure 8-15: Participant responses to the consideration of the relationship between course development and quality assurance

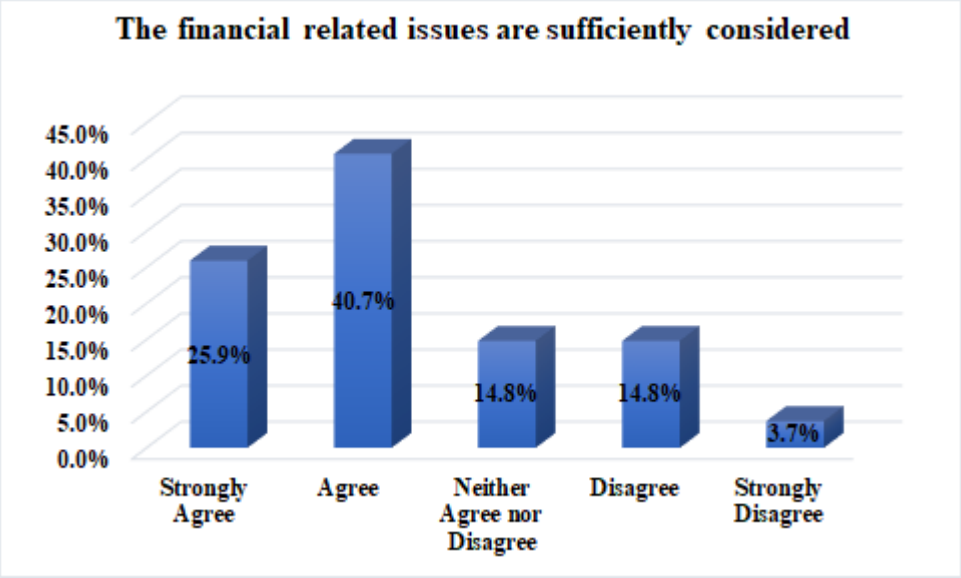


Figure 8-16: Participant responses on financial issues

Question 15 invited further comment, and the participants mentioned that the operation element should also include cloud resource management. In terms of the finance sub-element, they suggested that financing for cloud resources should be added, as should the cost of hosting, updating and upgrading the VLE.

Respondents also commented that staff support needed to be considered and should be added to the support sub-element. In addition, they stated that marketing costs are linked to the finance sub-element as universities need to spend a significant amount on marketing. Based upon this, a link was added between promotion/marketing and finance in the operation element. In addition, staff development has costs, so a link was added between this and finance in the operation element, as shown in Figure 48 (see Section 6.2.4). The participants' comments are discussed in Section 6.2.4.

8.1.2.6 EDUCATION ELEMENT

Figure 8-17 shows the education element and issues related with other elements.

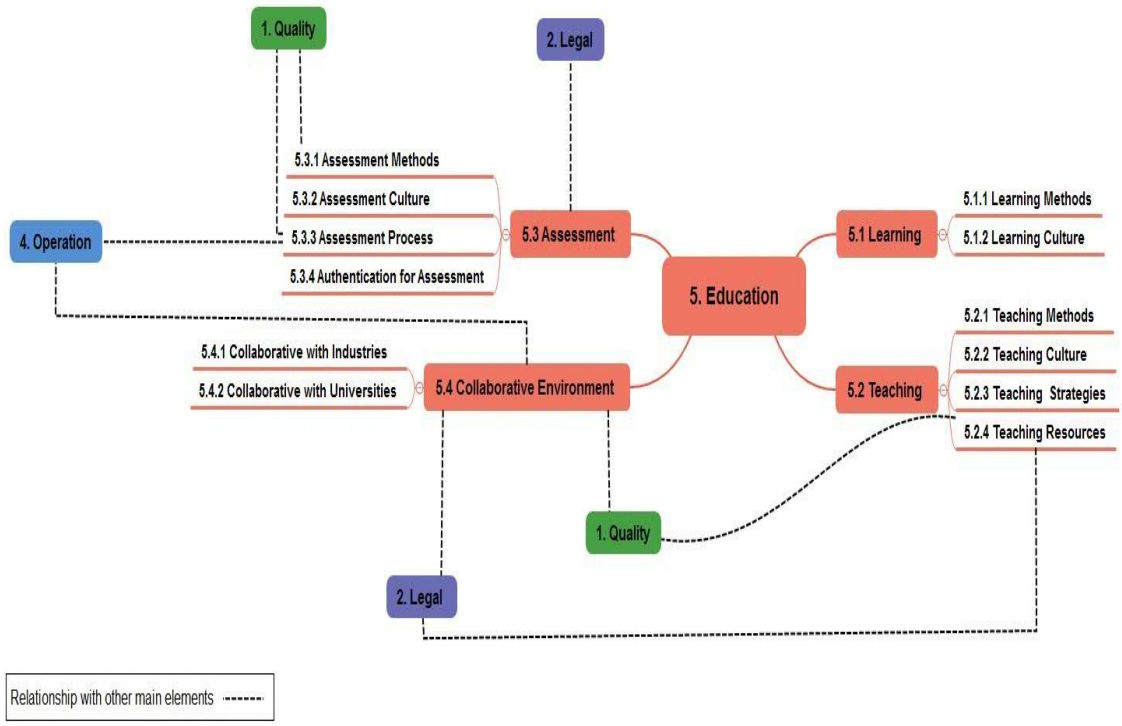


Figure 8-17: Education element associated with other elements and sub-elements

Table 8-7 shows the two questions used to evaluate Figure 8-17. One relates to the collaborative development of the assessment strategy, process, materials and related issues, and the second to the implementation of collaborative assessment. They were followed in the questionnaire by an open-ended question.

Table 8-7: Issues related to the education element – participant responses

No	Questions	Median	1: Strongly Agree	2: Agree	3: Neither Agree nor Disagree	4: Disagree	5: Strongly Disagree
16	The collaborative development of the assessment strategy, assessment process, materials and related issues are appropriately addressed	2	N =9	N=10	N= 5	N=2	N=1
17	The implementation of collaborative assessment is appropriately addressed	2	N =6	N=12	N=6	N=2	N=1

Table 8-7 shows that 70% of participants agreed or strongly agreed that the collaborative development of the assessment strategy, assessment process, materials and related issues were appropriately addressed. Furthermore, 67% agreed or strongly agreed that the implementation of collaborative assessment was appropriately addressed. Nearly 22% selected “neither agree nor disagree”. Figures 8-18 and 8-19 show the outcome.

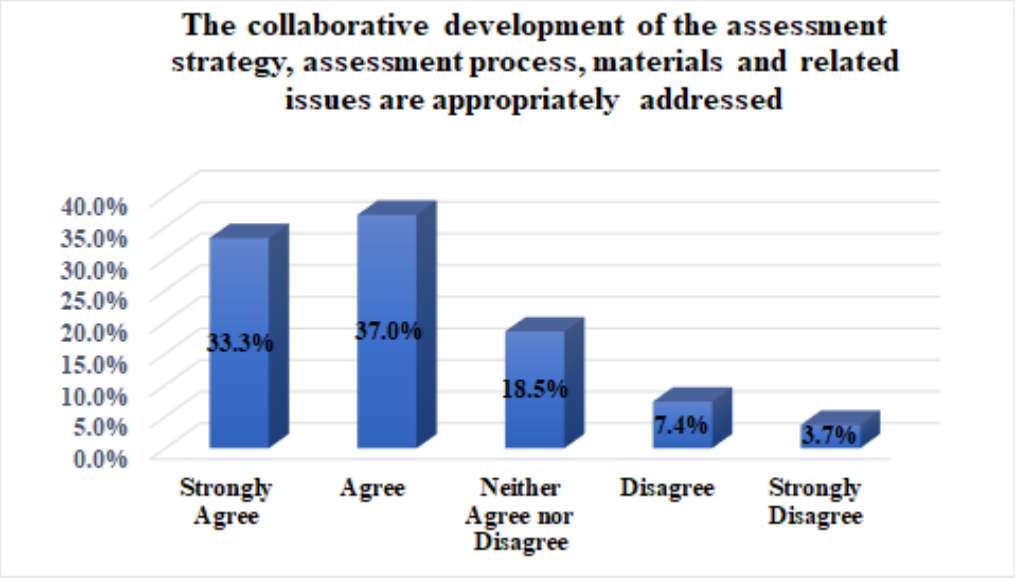


Figure 8-18: Participant responses concerning the collaborative development of assessment and related issues

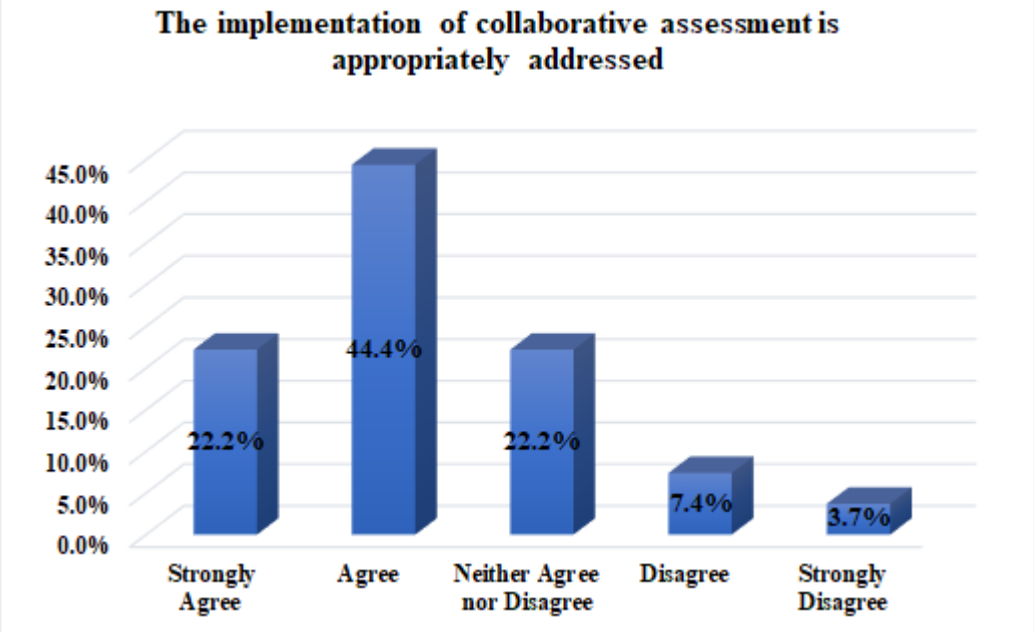


Figure 8-19: Participant responses concerning the implementation of collaborative assessment

Question 18 asked for further comment and the participants pointed out that the quality element should also cover all of the educational aspects (discussed in Section 6.2.5). In terms of the collaborative environment, respondents mentioned that universities should also consider collaboration between students, taking into account collaborative activities between students in relation to equality, diversity and inclusivity.

Table 8-8 shows the outcome for the question about the appropriateness of the framework elements and sub-element grouping.

Table 8-8: Grouping of elements and sub-elements – participant responses

No	Question	Median	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
19	The grouping of the elements and sub-elements for each element is appropriate	2	N = 4	N=14	N= 6	N=2	N=1

From Table 8-8, 67% of participants considered that, for each of the five elements, the grouping of the elements and sub-elements was appropriate. Nearly 22% selected the response "neither agree nor disagree". Figure 8-20 shows the participant responses.

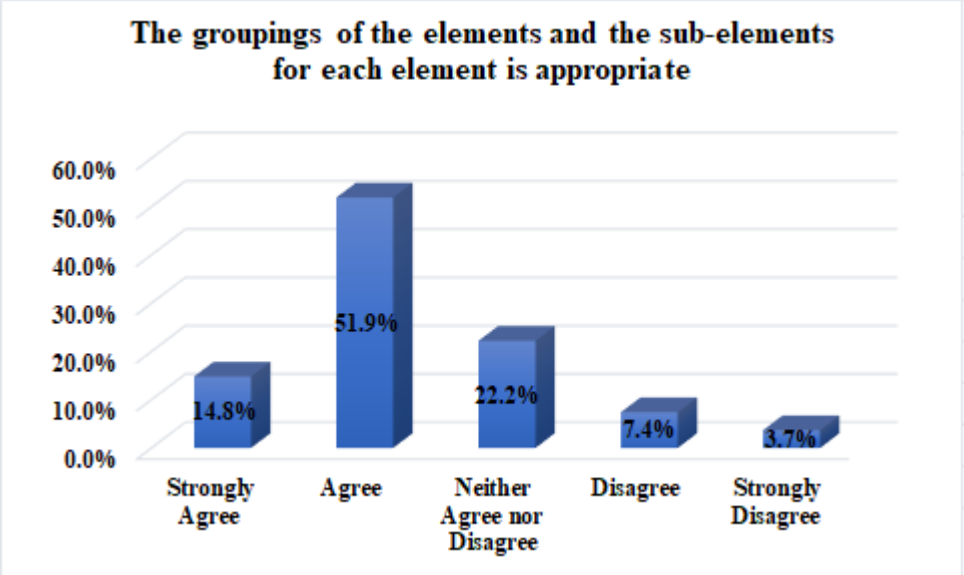


Figure 8-20: Participant responses concerning the grouping of the elements and sub-elements for each element

8.1.3 FRAMEWORK EVALUATION DISCUSSION

This section presents the discussion in relation to the four criteria defined in Section 8.1. The results showed the following:

- It was noted that the framework structure is appropriate, and the five main elements included in the framework are relevant and appropriate.
- The result shows that the grouping elements and sub-elements for each element are appropriate.

- It was noted that the issues associated with each element are comprehensive and considered. The participants also suggested that some issues were missing from each element and this was taken into account in and implemented in Chapter 6.

- The results show that the relationship between the elements is appropriate and considered. They suggest that some relationships are missing, as discussed in the previous section and addressed in Section 6.2.

8.2 EVALUATION OF THE PROTOTYPE

The developed prototype was evaluated by the same group of academics who evaluated the framework. The participants provided their views on the prototype, which had been developed to illustrate the concepts of part of the framework, by responding to a questionnaire. Non-random sampling was chosen for the evaluation, and the sample participants were twenty-one practitioners who could be categorised as either heads of educational technology departments or digital learning departments or senior academics from the computer science education departments and education departments. Each had expertise in the development or use of online courses. The prototype focused on the assessment process, development of assessment materials, and course development. In particular, it aimed to evaluate:

1) How the prototype enabled the user to understand the framework.

2) How well the prototype presented the relationship between the elements within the framework.

3) How well the prototype informed users about the completion of processes and their current status.

4) The overall ease of use of the prototype.

8.2.1 PROTOTYPE EVALUATION PROCESS

The participants were invited to give their views and opinions on the prototype by responding to six questions with Likert-type answers and one open-ended question. The open-ended question enabled the participants to add further comments if they felt that any part of the prototype should be modified. The introduction to the questionnaire included

three task scenarios: a) viewing the stages and status, b) viewing the details of each stage, c) editing the status.

The survey was conducted using the "SmartSurvey" website (Smartsurvey 2017) and was piloted by three academics in order to identify any possible errors in the questions, the structure of the questionnaire or its format.

Invitation emails were sent to the participants inviting them to take part in the evaluation. A separate document containing a user-manual (see Appendix L) for the prototype was also provided with the email. In addition, a video clip demonstrating the working of the prototype was made available on YouTube. The link to the prototype via a hosted webpage was included within the questionnaire. The login details were sent in the invitation email to each participant. The online survey was accessible for a period of four months.

8.2.2 PROTOTYPE SURVEY ANALYSIS AND RESULTS

Analysis of the survey results was conducted using SPSS version 26. The Cronbach's Alpha test value was 0.887, as shown in Table 8-9, which means the reliability of this study is considered to be good (Sekaran and Bougie 2016).

Table 8-9: Cronbach's Alpha test – Prototype survey

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardised Items	N of Items
.887	.889	6

Descriptive statistical analysis was used independently for each of the questions to summarise and describe the large amount of data collected. The median was used to indicate the common points of the participants' opinions. Charts were produced to present the results in a graphical form. Each of the questions in the questionnaire (except the one that asked for further comments) was evaluated using a five point Likert-type scale (1 = Strongly Agree, 2 = Agree, 3 = Neither Agree nor Disagree, 4 = Disagree, 5 = Strongly Disagree), and the responses are shown in Table 8-10.

Table 8-10: Prototype survey – participant responses

No	Questions	Median	1: Strongly Agree	2: Agree	3: Neither Agree nor Disagree	4: Disagree	5: Strongly Disagree
1	The prototype helped me to understand the status of completion of the processes	2	N = 5	N=11	N= 3	N=2	N=0
2	The prototype helped me to understand how the framework idea works	2	N=2	N=11	N=6	N=2	N=0
3	The information provided helped me to recognise the relationship between elements	2	N=1	N=10	N=5	N=5	N=0
4	The prototype helped me to increase my understanding of the suitability of the framework	2	N=1	N=10	N=5	N=5	N=0
5	The prototype helped me to utilise the framework effectively	3	N=2	N=4	N=6	N=9	N=0
6	The prototype is easy to use	4	N=8	N=7	N=3	N=3	N=0

Table 8-10 shows that 76% of participants strongly agreed or agreed that the prototype helped them to understand the completion status of processes. Figure 8-21 demonstrates the participant responses with regard to this question.

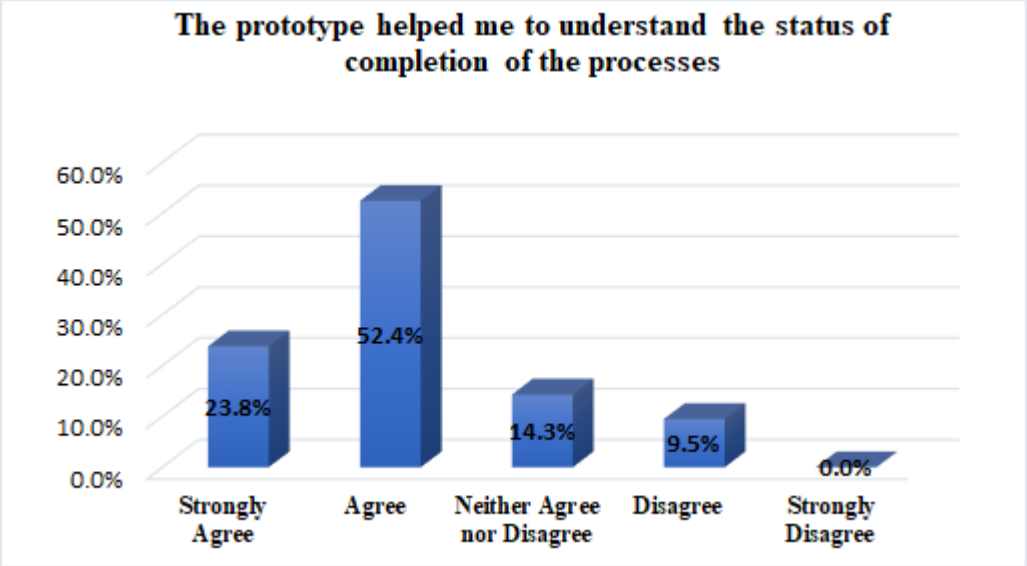


Figure 8-21: Participant responses with regard to understanding the status of process completion

Overall, 62% of participants strongly agreed or agreed that the prototype increased their understanding of how the framework idea worked. Figure 8-22 illustrates the participant responses to this question.

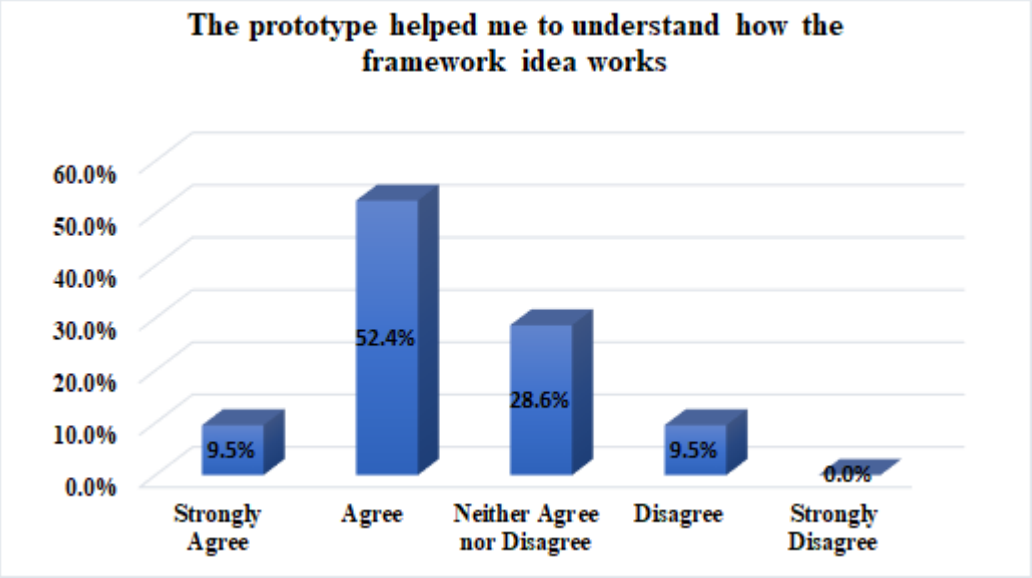


Figure 8-22: Participant responses with regard to understanding how the framework works

Table 8-10 shows that nearly 53% of participants strongly agreed or agreed that the information provided helped them to recognise the relationship between elements in the framework. Nearly 24% selected the "neither agree nor disagree" option, and 24% responded "disagree". These results indicate that the prototype presents the relationship between each element in the framework clearly. Figure 8-23 illustrates the participant responses to the question.

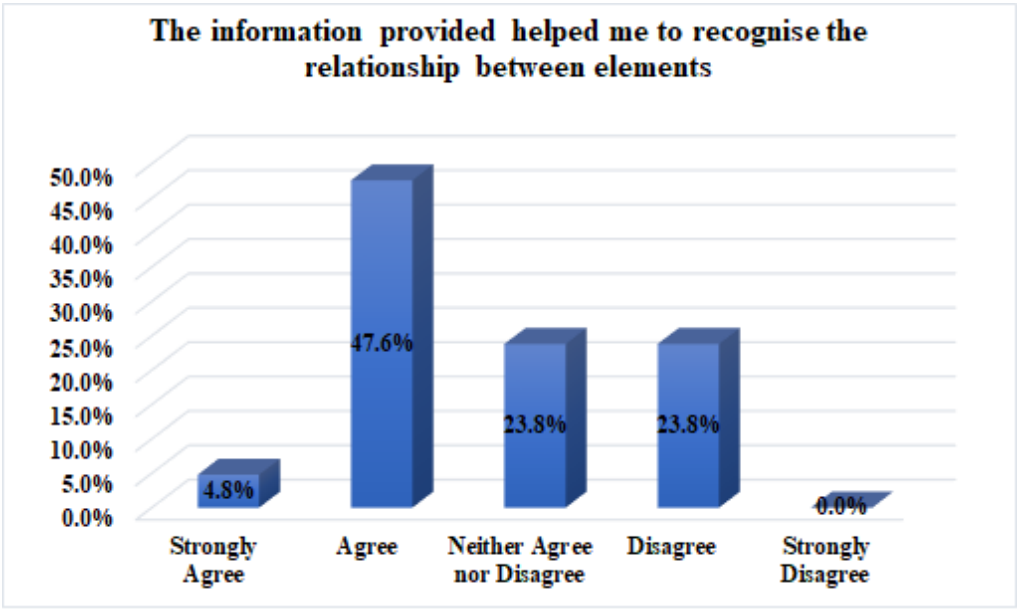


Figure 8-23: Participant responses regarding enhanced understanding of element relationships

Responses to question 4 in Table 8-10 indicate that nearly 53% of participants strongly agreed or agreed that the prototype helped users to increase their understanding of the suitability of the framework. Nearly 24% responded “neither agree nor disagree”, and 24% responded “disagree”. Figure 8-24 shows the responses.

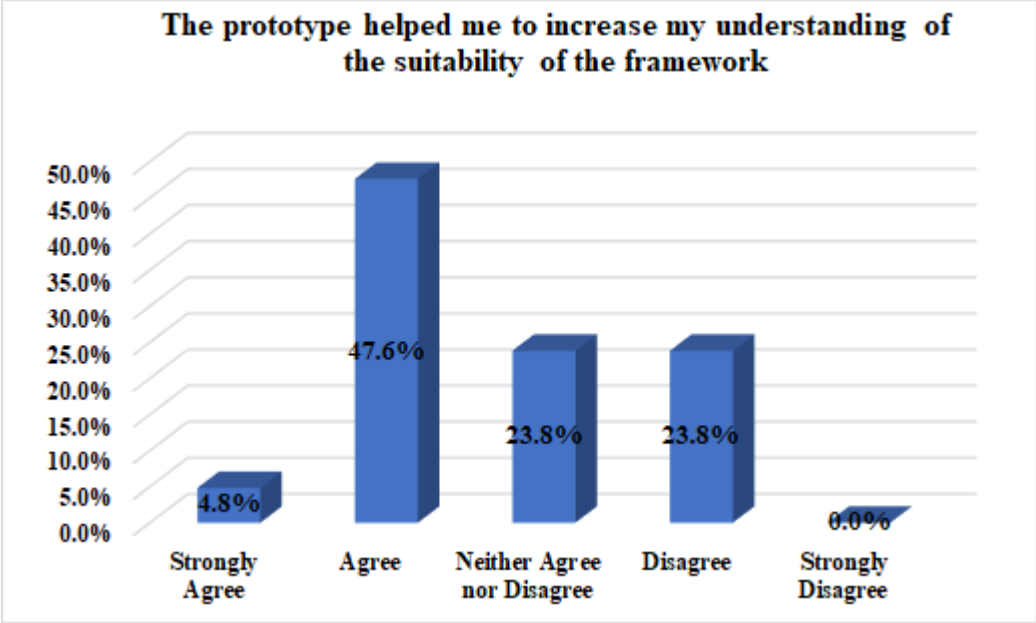


Figure 8-24: Participant responses regarding the prototype’s ability to explain the suitability of the framework

As shown in Table 8-10 for question 5, nearly 43% of participants disagreed that the prototype helped them to utilise the framework effectively. Figure 8-25 shows the participant responses.

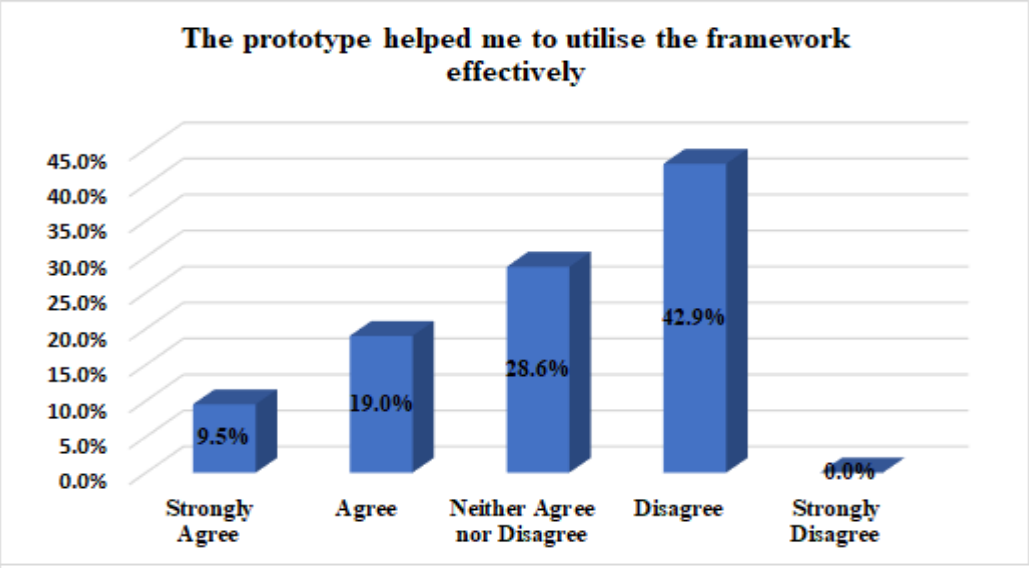


Figure 8-25: Participant responses about the prototype help the user to utilise the framework effectively

Seventy-one percent of participants strongly agreed or agreed that the prototype was easy to use. Figure 8-26 demonstrates the participant responses.

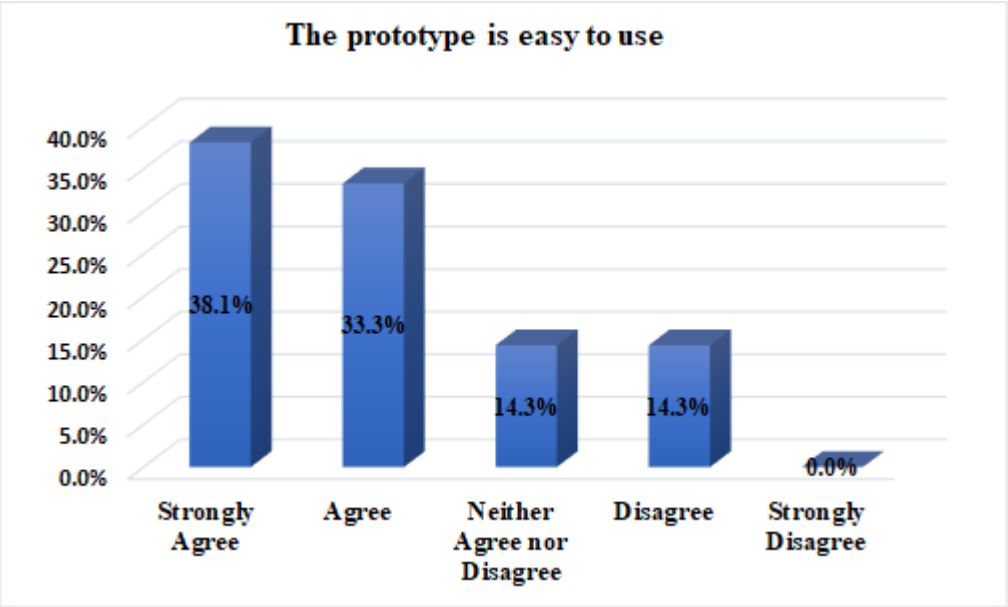


Figure 8-26: Participant responses concerning prototype ease to use

When asked to make further comments, the participants suggested that a few improvements to the menu (the navigation bar) should be made and that the titles on the left-hand side of the menu should be shorter. Also, they commented that the completion status display might include a 'Not started' stage before 'Not agreed', and that the relationships between the different elements could be made clearer with the use of colour coding. The comments will be added to the future work section.

Furthermore, the respondents liked the way the documents were made available and mentioned that the user interface was attractive and simple to use. They believed it would be a useful tool for anyone who needed to find out the status of development and how it related to other partners. It would also help the project leader to maintain an oversight of time-frames.

8.2.3 PROTOTYPE EVALUATION DISCUSSION

This section presents the discussion in relation to the four criteria defined in Section 8.2. The results showed the following:

- The prototype helped users to understand the framework idea.

- The information provided helped the user to understand the relationship between the elements.
- The prototype helped participants to understand the status of completion of processes.
- The prototype was easy to use.

8.3 SUMMARY

This chapter presents the approach taken to evaluate the appropriateness of the framework based on specific criteria. Five heads of educational technology and twenty-two senior academics with expertise in online courses were invited to comment on the framework. The evaluation results showed that the framework structure was appropriate. The participants indicated that the five main elements were relevant and comprehensive. They also commented on the appropriateness of the grouped elements and sub-elements within the framework. The results showed that the issues with each element were sufficiently considered. The participants also agreed that the relationships between the elements were appropriate. They indicated that some issues were missing in some of the elements and these were subsequently added.

This chapter also evaluated the prototype. The participants were five heads of educational technology and sixteen senior academics. The results showed that the prototype helped the participants to test their understanding of the framework and illustrated that the information provided helped them to check the relationship. It did not, however, help them to utilise the framework fully, because it had been designed to test the functionality of only a small part of the framework. The participants commented that the prototype was easy to use, and would be a useful tool for anyone who, for example, needed to check on progress and course development status. The next chapter will discuss the conclusions of the thesis and future work.

CHAPTER 9: CONCLUSIONS AND FUTURE WORK

This chapter summarises the research carried out and discusses the findings. The outcomes, contribution of the research to the body of knowledge, and ideas for future work are also outlined.

9.1 CONCLUSIONS

The main aim of the study was to develop a conceptual framework for a cloud-based collaborative environment for online course provision, as discussed in Chapter 1. The framework provides guidelines to universities for consideration prior to becoming involved in collaborative projects, and illustrates the elements and issues associated with collaborative environments. It also identifies the relationships between the elements and sub-elements. The research used a mixed-methods approach to data gathering and analysis prior to proposing the framework.

The literature review in this thesis provided the background for the research and the relevant studies. The topics presented include a brief history of online courses and their benefits, and related issues with regard to student learning culture, style, and experiences of dealing with and communicating with peers. Topics also include the issues associated with teaching culture, the role and experience of academics, finance, and course design. The review covers the technology used to deliver online courses and the benefits of collaborative learning and teaching (see Chapter 2), then moves on to consider cloud computing technology in terms of characteristics such as on-demand self-service, broad network access, resource pooling, rapid elasticity, and measured service. It includes a critical review of the different deployments of cloud computing and service models. It presents cloud computing benefits such as cost-saving, flexibility, availability, collaboration and sharing, scalability, mobility and reliability, and also discusses the application of cloud computing in education (see Chapter 3).

A collaborative environment for online course provision through cloud computing was proposed to address those issues related to online course delivery and operation. The environment would provide benefits to universities, academics and students. The sharing of course development between universities would improve the skills and experience of academics, whilst joint teaching could be expected to enhance both the quality and the experience of academics and to encourage instructors to change their teaching methods. Collaborative learning would develop students' understanding, knowledge and skills.

The use of cloud computing technology facilitates the collaborative environment between universities by enabling the sharing of IT resources. It can also reduce the cost of IT resources in a collaborative environment between universities for delivering online courses. Cloud computing enhances ease of access and availability for collaborative online course delivery. Besides this, it makes it easy for universities to enhance their collaborative online course delivery by taking advantage of availability, elasticity, ease of access, and mobility, etc. It provides access to remote IT resources such as storage and servers.

Despite the benefits of adopting a cloud-based collaborative environment, there are a number of issues and challenges that should be taken into consideration before such an environment is established.

This research used sequential exploratory mixed methods approaches (interviews and questionnaires) in two phases of data collection to explore the issues (see Chapter 4). Seven themes emerged from the interviews: culture, management and administration, technical issues, development of teaching resources, collaborative VLE, operational issues and rights. Further issues identified by the questionnaire were also investigated, namely quality assurance, quality of courses, confidentiality, student rights, compatibility issues with respect to regulations between universities, the collaboration between industries, and contract laws (see Chapter 5).

The initial seven themes, as shown in Figure 5-1 in Section 5.1, were derived by analysing the comments of the interviewees in the semi-structured interviews in the first phase of the primary research. The literature review, interviews and surveys together revealed a large number of issues, thus the grouping themes were revised, and related issues were grouped together to become five main themes, as presented in Figures 5-33 in Section 5.3. The themes were redefined to become the elements that make up the conceptual framework, which are also those of the cloud-based collaborative environment for online delivery: quality, legal, security, operation and education. The framework includes the elements and shows the relationship between them. Each element was divided into a number of sub-elements, and the relationships between them were identified. Each element was expanded by showing its relationship with other elements and sub-elements (see Chapter 6).

A prototype was designed to test a section of the framework for illustrative purposes of its implementation (see Chapter 7). The focus of the prototype was on checking

compliance with the processes, and more specifically, on checking the status of processes with respect to course development, assessment and development of assessment materials. The prototype illustrates some of the information which should be available to collaborative partners. It shows the steps and processes which should be carried out in the collaborative environment.

The framework and prototype were evaluated using two questionnaires. Academics with experience of the development and use of online courses from different universities in the UK, Australia and Saudi Arabia participated in this evaluation (see Chapter 8). Twenty-seven participants evaluated the framework, whereas twenty-one participants evaluated the prototype. The evaluation confirmed that the framework was an appropriate structure, and the main elements were relevant. The evaluators confirmed that the grouping of the elements and the sub-elements was also appropriate. The participants pointed out a number of missing issues which were subsequently added to the framework (see Chapter 8, Section 8.1.2 for the detail), and they confirmed that the prototype helped them to test the framework and illustrated some of its functions and relationships.

9.2 CONTRIBUTIONS TO KNOWLEDGE

The contribution of the thesis to the body of knowledge includes:

- An exploration of the issues associated with cloud-based collaborative environments for online course provision,
- A proposed novel conceptual framework that represents challenges and issues as elements and illustrates the relationships between them. The framework is unique in considering the issues that should be taken into consideration prior to adopting the collaborative environment between universities,
- Development of a prototype to demonstrate the use and functionality of part of the framework for a cloud-based collaborative environment,
- A methodology for analysing the evaluation of both framework and prototype,

9.3 FUTURE WORK

This research considered the issues associated with cloud-based collaborative environments for online course provision. The framework identified how these issues are

organised and illustrated the relationships between them. This provides opportunities for researchers to conduct further in-depth studies to explore a number of areas. These include:

Issues related to the cloud-based collaborative VLE: It should be noted that a wide range of issues related to cloud-based collaborative environments were identified in this research, and many of them require further studies in order to provide greater insight with regard to their impact on cloud-based collaborative VLEs between universities. One example is the cultural issues associated with gender, age and language which render some females reticent to communicate with males in group discussions and may limit engagement with collaborative discussion tools. Such issues should be investigated, and features related to cultural aspects incorporated into new cloud-based collaborative VLEs. According to Popov et al. (2014), students' perception on collaborative learning can be affected by intercultural students who are members in the same group. They argue that females' overall perceptions of collaborative learning are negatively affected by the cultural diversity of the group members.

This research discusses the security issues and mechanisms that will be used in authentication systems for assessment, but those related to the security, authentication for assessments and data privacy associated with cloud-based collaborative VLE need further investigation. According to Kausar (2020), VLE needs to be secured the content and data by protecting vulnerabilities in the system. In addition, it needs to protect various security attacks such as illegal authentication and access control, code injection attack and session hijacking.

Furthermore, there is a need for further studies on inactive features, and to consider adding new ones that would improve the quality of collaborative VLE. Researchers need to suggest a variety of tools that should be integrated with VLE to support the collaborative environment between students, instructors and staff. They need also to consider how these new tools might be integrated with VLE.

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APPENDICES

APPENDIX A: INTERVIEW QUESTIONS

Semi-structured Interview Questions

Q1: Which Kind of online courses do you offer? Who is the target?

Q2: What are the main issues you have faced in offering online courses (such as management issues, security, finance, etc.?

Q3: Do you offer real-time lectures as well as recorded lectures?

Q4: Are there an opportunity to interact with students in real-time lectures or recorded lecture?

Q5: Do you offer virtual laboratories?

Q6: Who is responsible for courses maintenance?

Q7: Do you have any concern about security?

Q8: Have you shared the delivery of online course with another university?

Q9: Have you considered migrating your online courses to the cloud?

Q10: What is your view about collaborative cloud-based online course provision?

Q11: If the courses are shared with other universities, do you think course ownership will be an issue if so, what do you think would be the solutions?

Q12: How can you share the development of teaching resources?

Q13: How do you think the cost of development can be shared?

Q14: For shared courses, who do you think would be responsible for students enrolment, is it one university or both?

Q15: Do you have any comment about cloud-based collaborative for online course provision?

Q16: How often do you obtain feedback from the students and how?

Bournemouth University

Participant information sheet

Study title:

A model for cloud-based collaborative online course provision.

Invitation:

You are being invited to take part in this research project conducted by May Aldoayan, a postgraduate researcher, in the Department of Computing and Informatics, Faculty of Science & Technology, Bournemouth University, UK. This study is part of her PhD thesis and is supervised by Dr. Reza Sahandi. Before you participate, it is important for you to understand why the research is being done and what will be involved. Please take time to read the following information carefully. Additional information will be provided, if required.

What is the purpose of the study?

To develop a model for a cloud-based collaborative online course provision.

Why you have been chosen?

You have been chosen because you are the person who experience with online courses.

Do you have to take part?

It is up to you to decide whether or not to take part. If you do decide to take part, you will be given this information sheet to inform you and be asked to sign a consent form. You can withdraw at any time, up to the point where the data are processed and become anonymous, so your identity cannot be determined. You do not have to give a reason for taking part or not.

what is expected from you?

In semi-structured interview , I will meet you to ask questions about online courses, baring in mind your experience. Alternatively, you will be invited to participate in an online survey where you will be invited to complete a questionnaire I will send the link to you by email link to access the questionnaire.

Will there be any risk in participating in the survey?

There are no risk of taking parts in this study.

What are the possible benefits of taking part?

After the analysis of the outcome of the survey, the information can be sent to you, if you are interested .

Page 1 of 2

Bournemouth University

Will the data gathered be kept confidential?

All the information recorded will be anonymous and any recorded audios will be destroyed at the end of the project.

What will happen to the results of the research project?

You will not be identified in any reports or publications. I will write up the findings in my PhD thesis as well as for publication in relevant Journals and conference proceeding.

Contact for further information

If you have any questions or require more information about this study, please contact me using the following contact details:

May Aldoayan
Faculty of Science and Technology
maldoayan@bournemouth.ac.uk
Bournemouth University
BH12 5BB
Tel: 01202 968140

Will I be recorded, and how will the recorded media be used?

Yes, if you take part in interview stage. The recording will help the research team to capture the information that will be sought from you during interviews. However, you will be given the right to accept or reject recording. No other use will be made of the recording without your written permission, and no one outside the research team will be allowed access to the original recordings. The audio recordings made during this research will be deleted once transcribed and anonymised. The transcription of interviews will not include your name or any identifiable information.

Thank you for reading this information sheet and for considering taking part in this research.

Bournemouth University

Participant's Consent Form

Study Title: A model for cloud-based collaborative online course provision

Researcher Information

May Aldoayan, PhD researcher
maldoayan@bournemouth.ac.uk
Faculty of Science & Technology
Bournemouth University

Supervisor Information

Dr. Reza Sahandi
rsahandi@bournemouth.ac.uk
Faculty of Science & Technology
Bournemouth University

	Please initial here
I have read and understood the participant information sheet for the above research project.	
I confirm that I have had the opportunity to ask questions.	
I understand that my participation is voluntary.	
I understand that I am free to withdraw up to the point where the data are processed and become anonymous, so my identity cannot be determined.	
During the tasks of the study, I am free to withdraw without giving a reason and without there being any negative consequences.	
Should I not wish to answer any particular question(s), complete a test, I am free to decline.	
I give permission for members of the research team to have access to my anonymised responses. I understand that my name will not be linked with the research materials, and I will not be identified or identifiable in the outputs that result from the research.	
I understand taking part in the research may include being recorded (audio) but that these recordings will be deleted once transcribed and anonymised.	
I agree to take part in the above research project.	

Name or Initials of the Participant	Date	Signature
Name or Initials of the Researcher	Date	Signature

Cloud-based collaborative online course provision survey

0%

1. Academic and Administrative Staff Survey

Page 1 of 3

This survey is being conducted for PhD research at Bournemouth University, United Kingdom. The research aim is to design a model to facilitate a cloud-based collaborative environment between universities for online course provision. The collaborative environment will provide students with the opportunity to develop their knowledge and skills through access to a much wider pool of teaching resources and academic staff from several universities. It will also enable students to participate in discussion boards to exchange Knowledge and experience. In addition, students will have access to learning materials in a virtual learning environment (VLE) any time.

The survey should take no more than 10 minutes. It is divided into two Parts:

A: Main Questions with regards to collaborative environment for online course provision
B: Optional Questions

Privacy and Confidentiality
All answers will be treated confidentially and respondents will be anonymised.
If you have any comments or inquiries please do not hesitate to contact the researcher via the email address below:

maldoayan@bournemouth.ac.uk

Thank you for participating in our survey. Your feedback is important

Next Page

Cloud-based collaborative online course provision survey

33%

2. A: Main Questions

Q1: Please select the most suitable answer for each statement:

1. Cultural Aspects *

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. I am very keen to share my teaching materials with colleagues in other universities	○	○	○	○	○
2. Working with academic colleagues in other universities is very exciting	○	○	○	○	○
3. Working with academic colleagues in other universities can be challenging	○	○	○	○	○
4. Joint development of assessment materials between universities can enrich the quality of assessment	○	○	○	○	○
5. Joint development of assessment materials for online courses can provide an opportunity to examine students' knowledge more accurately and effectively	○	○	○	○	○
6. I am very interested to share my assessment materials with academic colleagues in other universities	○	○	○	○	○
7. Joint design and development of assessment materials between universities is often challenging	○	○	○	○	○

2. Collaborative Aspects *

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
8. Discussion boards are very helpful to students for exchanging their knowledge and experience	○	○	○	○	○
9. It is more efficient and effective to share the management of online courses between collaborating universities	○	○	○	○	○
10. Sharing the task of updating and maintenance of teaching resources between collaborative universities is a good and effective approach	○	○	○	○	○
11. Sharing the development of course structures between universities will be problematic	○	○	○	○	○
12. Collaborative development and delivery of online courses is more cost-effective	○	○	○	○	○
13. Collaborative course provision by a group of universities can enrich student support and experience due to complementary knowledge which may be available	○	○	○	○	○

3. Management and Administration Aspects *

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
14. For improved reliability, more than one university in a collaborative team should set up the enrollment and administrative system	○	○	○	○	○
15. For a collaborative course provision, it is more effective if all the universities involved use their own student admission system	○	○	○	○	○

4. Ownership Aspects *

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
16. Ownership is a major issue between collaborative universities and it must be agreed at the start of collaboration	○	○	○	○	○
17. Copyright issues can deter collaboration between universities for online course provision	○	○	○	○	○
18. Legal agreements for collaborative course provision between universities are not necessary since universities are responsible for educating the public	○	○	○	○	○

5. Infrastructure and Security Aspects *

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
19. It is not necessary to designate one university for updating and maintenance of Virtual Learning Environment (VLE) tools for a collaborative environment for online course provision. This should be shared by the universities involved in collaboration	○	○	○	○	○
20. Academic staff may be anxious about security issues regarding student assessment and teaching resources, if the courses are accessed via the cloud	○	○	○	○	○

Q2: If there are any important issues which have not been covered by the above questions, please add to the box below?

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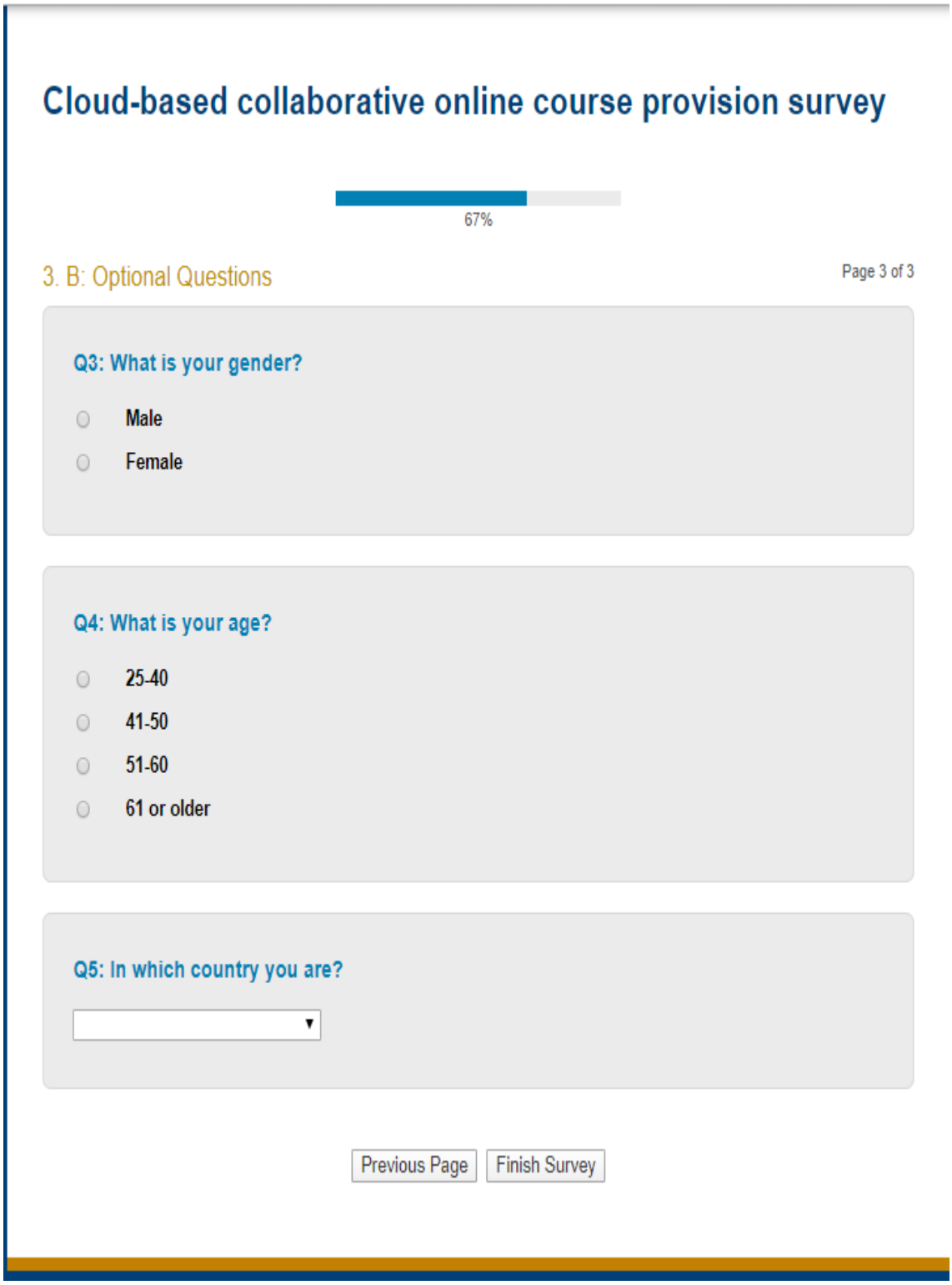
Cloud-based collaborative online course provision survey
67%
3. B: Optional Questions
Page 3 of 3
Q3: What is your gender?
Male
Female
Q4: What is your age?
25-40
41-50
51-60
61 or older
Q5: In which country you are?
Previous Page
Finish Survey

APPENDIX E: DESCRIPTIVE STATISTICAL ANALYSIS (MEDIAN, IQR AND FREQUENCY)

No	Statements	Median	IQR	1: Strongly Agree	2: Agree	3: Neutral	4: Disagree	5: Strongly Disagree
1. Culture Aspect								
1	*I am very keen to share my teaching materials with colleagues in other universities*	2	2	(N=21) 16.4%	(N=43) 33.6%	(N=31) 24.2%	(N=22) 17.2%	(N=11) 8.6%
2	*Working with academic colleagues in other universities is very exciting*	2	1	(N=49) 38.3%	(N=51) 39.8%	(N=24) 18.8%	(N=2) 1.6%	(N=2) 1.6%
3	*Working with academic colleagues in other universities can be challenging*	2	0	(N=20) 15.6%	(N=77) 60.2%	(N=26) 20.3%	(N=5) 3.9%	(N=0) 0%
4	*Joint development of assessment materials between universities can enrich the quality of assessment*	2	1	(N=25) 19.5%	(N=55) 43.0%	(N=39) 30.5%	(N=6) 4.7%	(N=3) 2.3%
5	*Joint development of assessment materials for online courses can provide an opportunity to examine students' knowledge more accurately and effectively*	3	1	(N=17) 13.3%	(N=46) 35.9%	(N=52) 40.6%	(N=11) 8.6%	(N=2) 1.6%
6	*I am very interested to share my assessments materials with academic colleges in other universities*	3	1	(N=19) 14.8%	(N=41) 32.0%	(N=41) 32.0%	(N=21) 16.4%	(N=6) 4.7%
7	*Joint design and development of assessment materials between universities is often challenging*	2	1	(N=31) 24.2%	(N=59) 46.1%	(N=30) 23.4%	(N=4) 3.1%	(N=4) 3.1%
2. Collaborative Aspect								
8	*Discussion boards are very helpful to students for exchanging their knowledge and experience*	2	1	(N=27) 21.1%	(N=57) 44.5%	(N=25) 19.5%	(N=15) 11.7%	(N=4) 3.1%
9	*It is more efficient and effective to share the management of online courses between collaborating universities*	3	2	(N=10) 7.8%	(N=22) 17.2%	(N=57) 44.5%	(N=34) 26.6%	(N=5) 3.9%
10	*Sharing the task of updating and maintenance of teaching resources between collaborative universities is a good and effective approach*	3	1	(N=9) 7.0%	(N=46) 35.9%	(N=54) 42.2%	(N=16) 12.5%	(N=3) 2.3%
11	*Sharing the development of course structure between universities will be problematic*	2	1	(N=28) 21.9%	(N=53) 41.4%	(N=26) 20.3%	(N=19) 14.8%	(N=2) 1.6%

12	*Collaborative development and delivery of online courses is more cost effective*	3	1	(N=5) 3.9%	(N=32) 25.0%	(N=64) 50.0%	(N=21) 16.4%	(N=6) 4.7%
13	*Collaborative course provision by a group of universities can enrich student support and experience due to complementary knowledge which may be available*	2	1	(N=16) 12.5%	(N=62) 48.4%	(N=33) 25.8%	(N=14) 10.9%	(N=3) 2.3%
3. Management and Administration Aspects								
14	*For improved reliability, more than one university in a collaborative team should set up the enrolment and administrative system*	3	1	(N=8) 6.3%	(N=19) 14.8%	(N=58) 45.3%	(N=29) 22.7%	(N=14) 10.9%
15	*For a collaborative course provision, it is more effective if all the universities involved use their own student admission system*	3	1	(N=11) 8.6%	(N=43) 33.6%	(N=52) 40.6%	(N=18) 14.1%	(N=4) 3.1%
4. Ownership								
16	*Ownership is a major issue between collaborative universities, and it must be agreed at the start of the collaboration*	1	1	(N=70) 54.7%	(N=47) 36.7%	(N=7) 5.5%	(N=1) 0.8%	(N=3) 2.3%
17	*Copyright issues can deter collaboration between universities for online course provision*	2	2	(N=49) 38.3%	(N=47) 36.7%	(N=24) 18.8%	(N=4) 3.1%	(N=4) 3.1%
18	*Legal agreements for collaborative course provision between universities are not necessary since universities are responsible for educating the public*	4	2	(N=10) 7.8%	(N=12) 9.4%	(N=18) 14.1%	(N=48) 37.5%	(N=40) 31.3%
5. Infrastructure and Security Aspects								
19	*It is not necessary to designate one university for updating and maintenance of Virtual Learning Environment (VLE) tools for a collaborative environment for online course provision. This should be shared by the universities involved in collaboration*	3	2	(N=10) 7.8%	(N=38) 29.7%	(N=32) 25.0%	(N=39) 30.5%	(N=9) 7.0%
20	*Academic staff may be anxious about security issues regarding student assessment and teaching resources if the courses are accessed via the cloud*	2	1	(N=25) 19.5%	(N=69) 53.9%	(N=21) 16.4%	(N=11) 8.6%	(N=2) 1.6%

Collaborative cloud-based online course provision survey

0%

1. Student Survey

Page 1 of 3

This survey is being conducted for PhD research at Bournemouth University, United Kingdom. The research aim is to design a model to facilitate a cloud-based collaborative environment between universities for online course provision. The collaborative environment will provide students with the opportunity to develop their knowledge and skills through access to a much wider pool of teaching resources and academic staff from several universities. It will also enable students to participate in discussion boards to exchange Knowledge and experience. In addition, students will have access to learning materials in a virtual learning environment (VLE) any time.

The survey should take no more than 10 minutes. It is divided into two Parts:

A: Main Questions with regards to collaborative environment for online course provision.
B: Optional Questions.

Privacy and Confidentiality
All answers will be treated confidentially and respondents will be anonymised.

If you have any comments or inquiries please do not hesitate to contact the researcher via the email address below:

maldoayan@bournemouth.ac.uk

Thank you for participating in our survey. Your feedback is important.

Next Page

Collaborative cloud-based online course provision survey

33%

2. A: Main Questions

Q1: Please select the most suitable answer for each statement: *

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. I am familiar with using online learning materials and approaches	○	○	○	○	○
2. I am familiar with online course assessments	○	○	○	○	○
3. An online course which is delivered by more than one university can provide an enriched education	○	○	○	○	○
4. I am very keen to exchange my knowledge and experience with other students who are on an online course with me	○	○	○	○	○
5. I prefer to use discussion boards to improve my ability to express myself and to share my ideas with other students	○	○	○	○	○
6. Communication between students from different cultures and background will encourage them to participate in group discussions and students forums	○	○	○	○	○
7. Using Virtual Learning Environment (VLE) tools to communicate in English with other students will improve my language and technical skills	○	○	○	○	○
8. I am interested to participate at live group discussions even during unsociable hours	○	○	○	○	○
9. Collaboration between universities for online course provision can positively affect my decision to enroll on the course	○	○	○	○	○
10. Student support in a collaborative environment will be more effective since there is an opportunity for more than one university to provide the response	○	○	○	○	○
11. Tuition fee is not an influencing factor, as long as an online course is delivered by a group of collaborative universities	○	○	○	○	○

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Collaborative cloud-based online course provision survey

67%

3. B: Optional Questions

Q2: What is your gender?

- Male
- Female

Q3: What is your age?

- 18-30
- 31-40
- 41-50
- 51-60
- 61 or older

Q4: In what Country do you reside in?

Previous Page | Finish Survey

APPENDIX G: DESCRIPTIVE STATISTICAL ANALYSIS (MEDIAN, IQR AND FREQUENCY) FOR STUDENT SURVEY

No	Statements	Median	IQR	1: Strongly Agree	2: Agree	3: Neutral	4: Disagree	5: Strongly Disagree
1	*I am familiar with using online learning materials and approaches*	2	1	(N=54) 41.5%	(N=54) 41.5%	(N=16) 12.3%	(N=5) 3.8%	(N=1) 0.8%
2	*I am familiar with online course assessments*	2	2	(N=37) 28.5%	(N=52) 40.0%	(N=28) 21.5%	(N=11) 8.5%	(N=2) 1.5%
3	*An online course which is delivered by more than one university can provide an enriched education*	2	1	(N=26) 20.0%	(N=56) 43.1%	(N=42) 32.3%	(N=6) 4.6%	(N=0) 0%
4	*I am very keen to exchange my knowledge and experience with other students who are on an online course with me.*	2	1	(N=27) 20.8%	(N=61) 46.9%	(N=32) 24.6%	(N=9) 6.9%	(N=1) 0.8%
5	*I prefer to use discussion boards to improve my ability to express myself and to share my ideas with other students*	2	1	(N=24) 18.5%	(N=52) 40.0%	(N=30) 23.1%	(N=20) 15.4%	(N=4) 3.1%
6	*Communication between students from different cultures and backgrounds will encourage them to participate in group discussions and student forums*	2	2	(N=35) 26.9%	(N=60) 46.2%	(N=26) 20.0%	(N=7) 5.4%	(N=2) 1.5%
7	*Using VLE tools to communicate in English with other students will improve my language and technical skills*	2	1	(N=32) 24.6%	(N=54) 41.5%	(N=34) 26.2%	(N=6) 4.6%	(N=4) 3.1%
8	*I am interested in participating in live group discussions even at unsociable hours*	3	1	(N=13) 10.0%	(N=43) 33.1%	(N=44) 33.8%	(N=21) 16.2%	(N=9) 6.9%
9	*Collaboration between universities for online course provision can positively affect my decision to enrol on the course*	2	1	(N=21) 16.2%	(N=53) 40.8%	(N=45) 34.6%	(N=8) 6.2%	(N=3) 2.3%
10	*Student support in a collaborative environment will be more useful since there is an opportunity for more than one university to provide a response*	2	1	(N=19) 14.6%	(N=65) 50.0%	(N=39) 30.0%	(N=5) 3.8%	(N=2) 1.5%

11	*Tuition fee is not an influencing factor, as long as an online course delivered by a group of collaborative universities*	4	1	(N=7) 5.4%	(N=25) 19.2%	(N=37) 28.5%	(N=44) 33.8%	(N=17) 13.1%

APPENDIX H: KRUSKAL-WALLIS TEST (STUDENTS)

	Statements	Age	N	Mean Rank	Asymp. Sig (2-tailed)
1	*I am familiar with using online learning materials and approaches*	18-30	49	62.18	.135
		31-40	61	72.39	
		41-50	15	57.37	
		51-60	3	45.50	
		61 or older	2	27.50	
2	*I am familiar with online course assessments*	18-30	49	65.55	.075
		31-40	61	71.37	
		41-50	15	48.37	
		51-60	3	62.00	
		61 or older	2	19.00	
3	*An online course which is delivered by more than one university can provide an enriched education*	18-30	49	62.79	.787
		31-40	61	67.16	
		41-50	15	62.63	
		51-60	3	73.50	
		61 or older	2	91.00	
4	*I am very keen to exchange my knowledge and experience with other students who are on an online course with me.*	18-30	49	68.56	.929
		31-40	61	63.43	
		41-50	15	63.13	
		51-60	3	73.50	
		61 or older	2	59.25	
5	*I prefer to use discussion boards to improve my ability to express myself and to share my ideas with other students*	18-30	49	70.89	.349
		31-40	61	59.25	
		41-50	15	68.50	

		51-60	3	90.17	
		61 or older	2	64.50	
6	*Communication between students from different cultures and background will encourage them to participate in group discussions and students' forums*	18-30	49	67.16	.729
		31-40	61	61.53	
		41-50	15	72.53	
		51-60	3	79.83	
		61 or older	2	71.50	
7	*Using Virtual Learning Environment (VLE) tools to communicate in English with other students will improve my language and technical skills*	18-30	49	64.09	.723
		31-40	61	63.70	
		41-50	15	71.83	
		51-60	3	88.83	
		61 or older	2	72.50	
8	*I am interested to participate at live group discussions even during unsociable hours*	18-30	49	69.52	.138
		31-40	61	59.70	
		41-50	15	66.00	
		51-60	3	79.83	
		61 or older	2	118.50	
9	*Collaboration between universities for online course provision can positively affect my decision to enrol on the course*	18-30	49	70.12	.516
		31-40	61	61.11	
		41-50	15	62.87	
		51-60	3	89.50	
		61 or older	2	70.00	
10	*Student support in a collaborative environment will be more effective since there is an opportunity for more than on university to provide the response*	18-30	49	68.53	.450
		31-40	61	60.33	
		41-50	15	73.83	
		51-60	3	62.67	

		61 or older	2	90.75	
11	*Tuition fee is not an influencing factor, as long as an online course delivered by a group of collaborative universities*	18-30	49	64.29	.057
		31-40	61	60.46	
		41-50	15	82.00	
		51-60	3	67.67	
		61 or older	2	122.00	

APPENDIX I: THE FRAMEWORK QUESTIONNAIRE

A framework for cloud-based online course provision survey

1. A survey for the evaluation of a Framework for cloud-based online course provision

0%

This Survey is being conducted for a PhD research at Bournemouth University, United Kingdom. The research aim was to design a framework for a cloud-based collaborative online course provision. The framework is designed to identify elements which should be taken into consideration prior to adopting a cloud-based collaborative environment between universities. The framework contains five key elements as shown in Figure 1(in page 3). The purpose of the survey is to evaluate the Framework, its structure, elements and the relationships between them. Figures 2 to 6 (in page 3) show the details of each element in the Framework.

Privacy and Confidentiality

All responses will be treated confidentially and will be anonymised.

Any personal information will be deleted at the end of this research.

If you have any comments or require further information, please do not hesitate to contact the researcher via email address below:

May Aldoayan

maldoayan@bournemouth.ac.uk

Consent to Participate

I confirm that I have read and understood the information provided and I agree to take part in the study.

- I consent to participate in the survey, begin the survey
- I do not consent, close the survey.

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A framework for cloud-based online course provision survey

33%

Q1: What is your role?

*

- Academic staff
- Program administrator
- Technician
- Other (please specify):

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A framework for cloud-based online course provision survey

67%

Q2. Please rate the following elements of the Framework and the relationship between each element?

Section A: The Framework (see Figure 1)

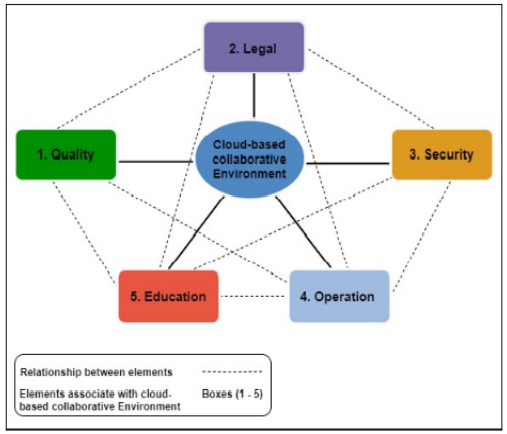

Figure 1. The Framework

*

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
1. The structure of the framework is appropriate					
2. The main elements chosen for a cloud-based collaborative environment for online courses are relevant and appropriate					

3. Please add any further comments?

Section B: The key elements and related issues (Figure 2 to Figure 6)

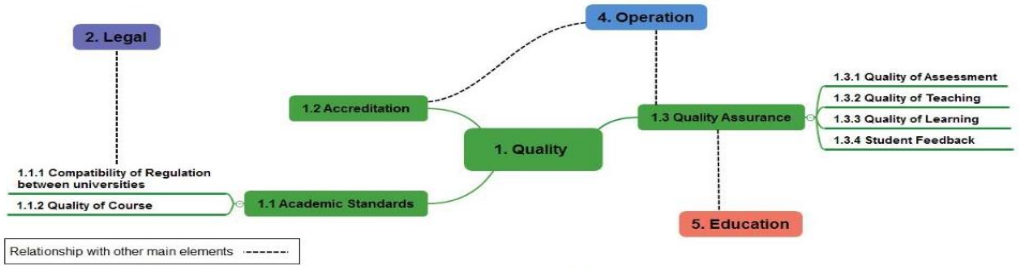

Figure 2. Quality Element

*

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
4. The quality assurance process is appropriately addressed					

5. Please add any further comments?

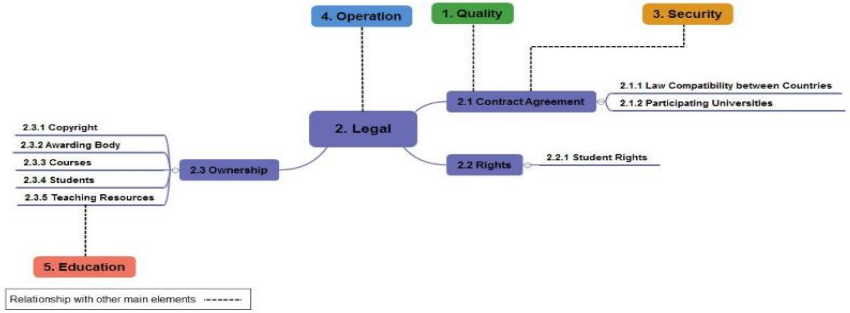

Figure 3. Legal Element

*

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
6. The legal and related issues are sufficiently covered					
7. The framework clearly illustrates how ownership can be protected					

8. Please add any further comments?

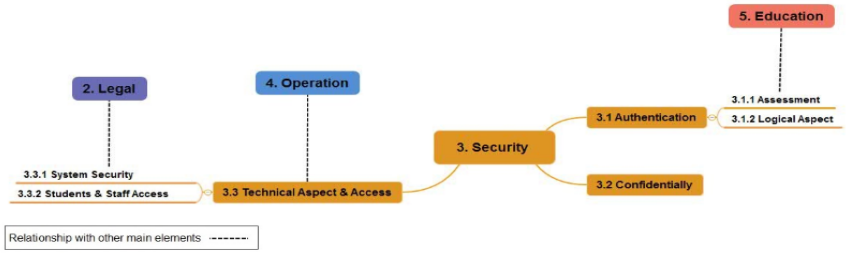

Figure 4. Security Element

*

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
9. The security and authentication for accessing materials are appropriately addressed					
10. The security and authentication for online assessments are sufficiently addressed					

11. Please add any further comments?

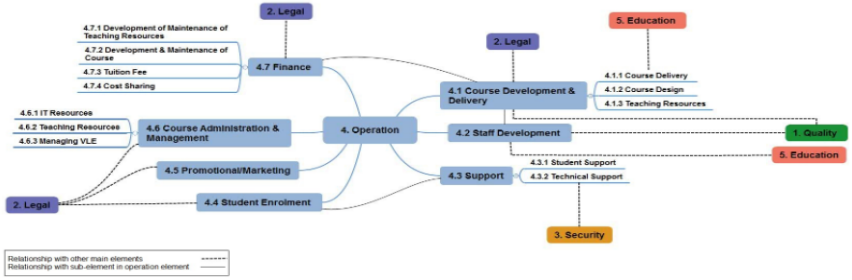

Figure 5. Operation Element

*

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
12. The operational issues are appropriately considered					
13. The quality assurance process relating to course development and delivery are sufficiently considered					
14. The financial related issues are sufficiently considered					

15. Please add any further comments?

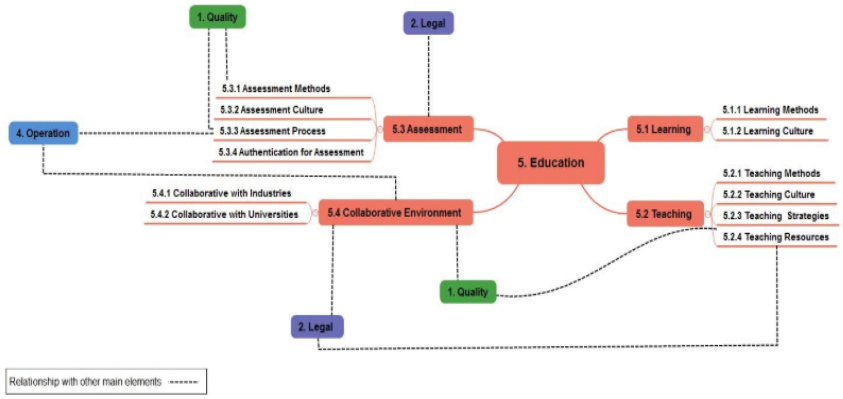

Figure 6. Education Element

*

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
16. The collaborative development of the assessment strategy, assessment process, materials and related issues are appropriately addressed					
17. The implementation of collaborative assessment is appropriately addressed					

18. Please add any further comments?

(Please See Figure 2 to Figure 6 and answer) *

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
19. The groupings of the elements and the sub-elements for each element is appropriate					

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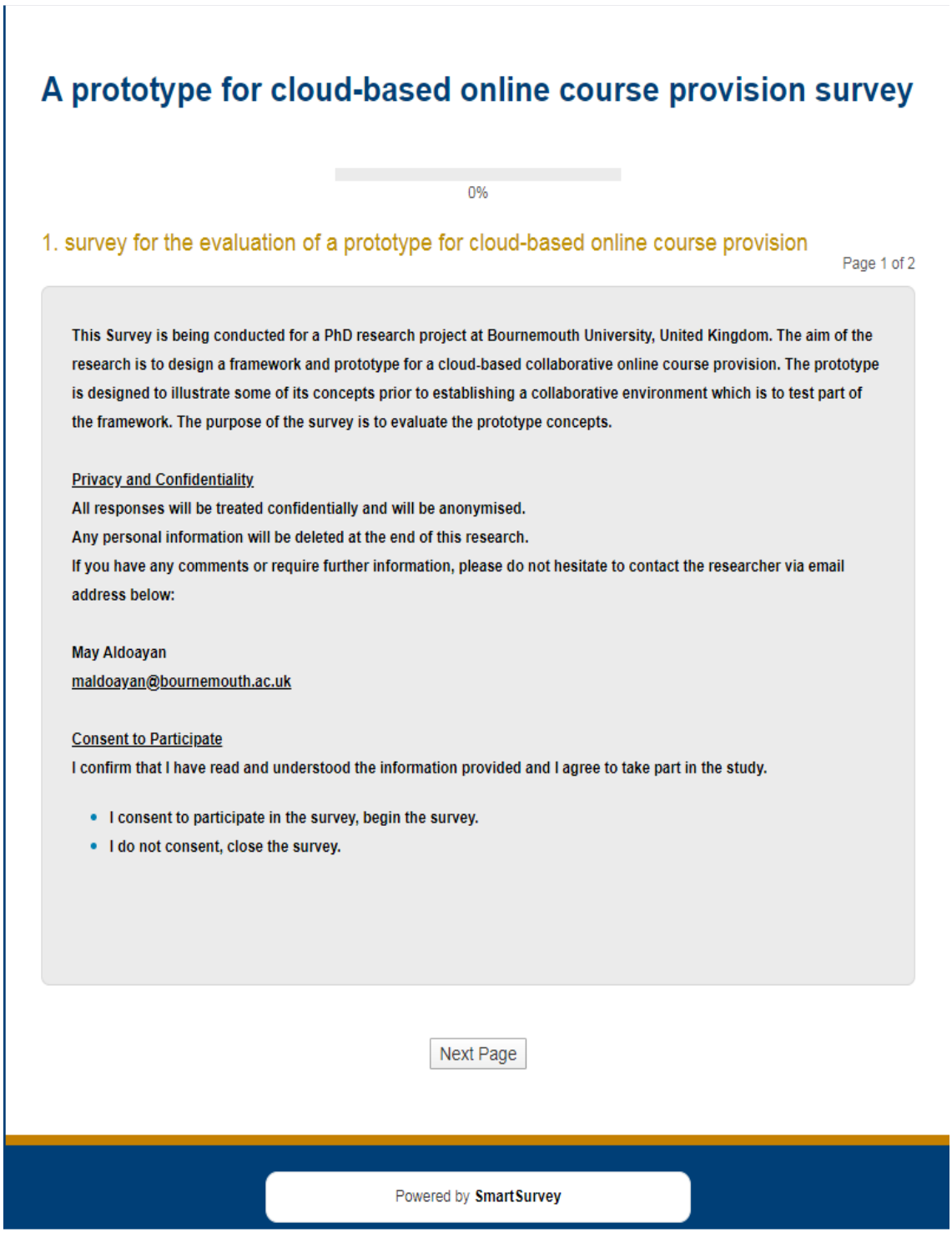

A prototype for cloud-based online course provision survey

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1. survey for the evaluation of a prototype for cloud-based online course provision

Page 1 of 2

This Survey is being conducted for a PhD research project at Bournemouth University, United Kingdom. The aim of the research is to design a framework and prototype for a cloud-based collaborative online course provision. The prototype is designed to illustrate some of its concepts prior to establishing a collaborative environment which is to test part of the framework. The purpose of the survey is to evaluate the prototype concepts.

Privacy and Confidentiality

All responses will be treated confidentially and will be anonymised.

Any personal information will be deleted at the end of this research.

If you have any comments or require further information, please do not hesitate to contact the researcher via email address below:

May Aldoayan

maldoayan@bournemouth.ac.uk

Consent to Participate

I confirm that I have read and understood the information provided and I agree to take part in the study.

- I consent to participate in the survey, begin the survey.
- I do not consent, close the survey.

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A prototype for cloud-based online course provision survey

50%

A prototype to test part of the framework for a cloud-based collaborative environment for online course provision has been developed which can be accessed via http://myccocp.com/newsite/CBCOCP/index.php. It allows a member user and course administrator to see the stages and status of completion of: course development, assessment process and development of assessment materials. It allows a member user to view the details such as agreed documentation. It also shows the date and time for any changes to the document. It will enable the course administrator to edit the status for the stages of: assessment process, development of assessment materials, and course development.

Please watch the video (https://www.youtube.com/watch?v=UH-jLprQdsw) or read the attached user manual in respect of the prototype. To participate in the evaluation process follow the task scenarios through the web link (http://myccocp.com/newsite/CBCOCP/index.php), and respond to the questions:

Task Scenarios:

1. Viewing the stages and status

The prototype shows the stages and status for: course development, assessment process and development of assessment materials. Assume you are a member of one of the universities involved in the collaboration, would you kindly visit (http://myccocp.com/newsite/CBCOCP/index.php) to evaluate the clarity of these stages.

- Select a collaborative course, then view the status for each of the three processes for each university involved in the collaboration.
- Users can view each stage and status for each process if the whole process has not completely been agreed.

2. Viewing the details of each stage

The prototype shows the details for each of the three processes: course development, assessment process and development of assessment materials. Assume you are a member of one of the universities involved in the collaboration would you kindly evaluate the clarity and suitability of the process.

- Please select from the navigation bar and view details of: assessment process completion stages, development of assessment materials, their completion stages.
- Select the university you wish to view their details.

3. Editing the status

The prototype allows the administrator to update the status for each stage if it is (not fully agreed by the partners) for: assessment process, development of assessment materials, course development process. Assume you are a course administrator for course 'X'. Would you kindly evaluate the clarity for updating the status for each stage.

- From the navigation select edit details for: assessment process completion stages, development of assessment materials, completion stages and course development completion stages.
- Select the university (such as XU) you need to edit status and edit the status and press update.

Q1: Please select the most suitable answer for each statement *

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
1. The prototype helped me to understand the status of completion of the processes	○	○	○	○	○
2. The prototype helped me to understand how the framework idea works	○	○	○	○	○
3. The information provided helped me to recognize the relationship between elements	○	○	○	○	○
4. The prototype helped me to increase my understanding of the suitability of the framework	○	○	○	○	○
5. The prototype helped me to utilise the framework effectively	○	○	○	○	○
6. The prototype is easy to use	○	○	○	○	○

Q2: Please add any comments if any part of the prototype should to be modified?

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Ref & Version: 1
Ethics ID: 27843
Date: 14/08/2019

Bournemouth University

Participant Information Sheet

The title of the research project

A framework for cloud-based collaborative online course provision.

What is the purpose of the research/questionnaire?

The aim of the questionnaires is to evaluate the framework and the prototype for a cloud-based collaborative online course provision.

Why have I been chosen?

You have been chosen due to your expertise and involvement with online courses.

Do I have to take part?

It is up to you to decide whether or not to take part. If you do decide to take part, you will be given this information sheet to read and be asked to sign a consent form. You can withdraw from participation at any time and without giving a reason, simply by closing the browser page. Please note that once you have completed and submitted your survey responses, we are unable to remove your anonymised responses from the study. Deciding to take part or not will not impact upon you

How long will the questionnaire/online survey take to complete?

The both two questionnaires will take around 20 minutes to be completed.

What are the advantages and possible disadvantages or risks of taking part?

Whilst there are no immediate benefits for those people participating in the project, it is hoped that this work will be analysed, and the outcome of the survey can be sent to you if you are interested. There is no risk of taking parts in this study.

What type of information will be sought from me and why is the collection of this information relevant for achieving the research project's objectives?

The First questionnaire is designed to evaluate the framework and the second questionnaire is to evaluate the prototype. The framework questionnaire is to evaluate the framework structure, key elements selected and the relationship between them. The prototype questionnaire which will be built to develop part of the framework

Use of my information

Participation in this study is on the basis of consent: you do not have to complete the surveys, and you can change your mind at any point before submitting the survey responses. We will use your data on the basis that it is necessary for the conduct of research, which is

an activity in the public interest. We put safeguards in place to ensure that your responses are kept secure and only used as necessary for this research study and associated activities such as a research audit. Once you have submitted your survey response it will not be possible for us to remove it from the study analysis because you will not be identifiable.

All research data collected for the purposes of this study will be held for 2 years, after which is will be deleted.

The information collected may be used in an anonymous form to support other research projects in the future and access to it in this form will not be restricted. It will not be possible for you to be identified from this data.

Contact for further information

If you have any questions or would like further information, please contact please contact me using the following contact details:

May Aldoayan
Faculty of Science and Technology
maldoayan@bournemouth.ac.uk
Bournemouth University
BH12 5BB
Tel: 01202 968140

Supervisor Information

Professor Reza Sahandi
rsahandi@bournemouth.ac.uk
Faculty of Science & Technology
Bournemouth University

In case of complaints

Any concerns about the study should be directed to Professor Tiantian Zhang, Deputy Dean for Research & Professional Practice, Faculty of Science & Technology, Bournemouth University by email to researchgovernance@bournemouth.ac.uk.

User Manual for cloud-based collaborative online course provision

Table of Contents

Table of Figures

1. Introduction:

A conceptual framework to facilitate cloud-based collaborative online course provision (CBCOCP) has been developed. A prototype has been designed to test part of the framework and to illustrate some of its concepts prior to establishing a collaborative environment for online course provision. The prototype is designed to help the partner universities to check compliance with the process of preventing and forthcoming collaborative issues avoiding detrimental effects. The prototype focuses on the completion stages for: assessment processes, development of assessment materials and course development. The system has two types of the user: member user and administrator.

2. Functions:

2.1 Viewing the stages and status

Member users and administrators can log in to the system. Collaborative courses can be selected, which will be associated with the universities involved in the collaboration (see Figure 1).

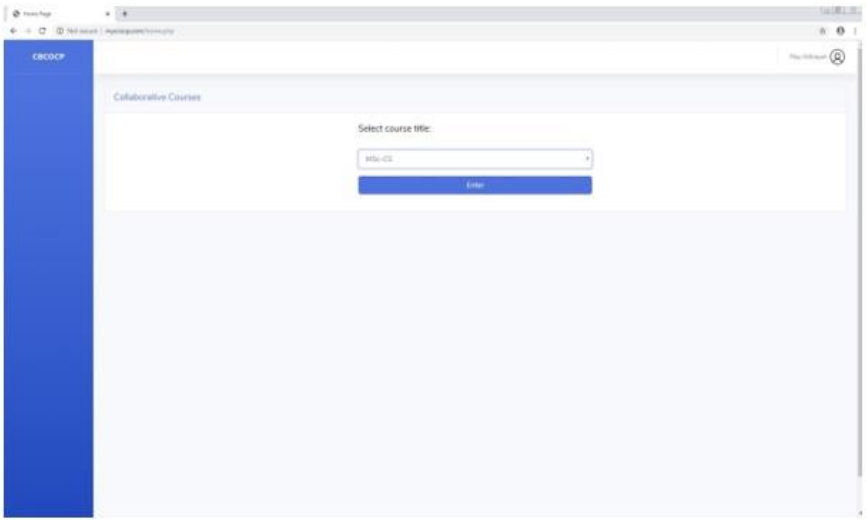

Figure 1. Collaborative courses page

Then the user can see the final status for the completion stages by the buttons colours. Yellow button had shown if the stages not completely agreed, whereas green button indicated when the stages completely agreed (see figure2).

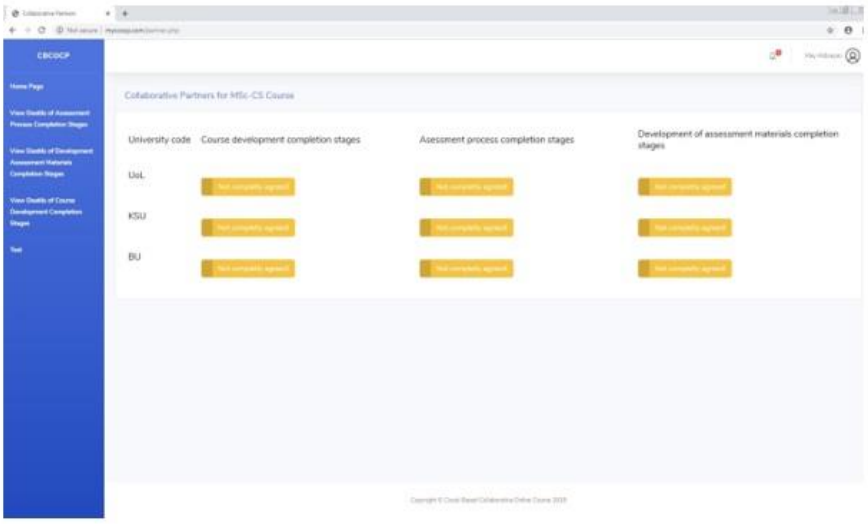

Figure 2. Collaborative partner and status for each process

User can press on the yellow button, to see each status for each stage in detail (see figure 3). If the button is green, that means all the stages are agreed, so there is no need to check.

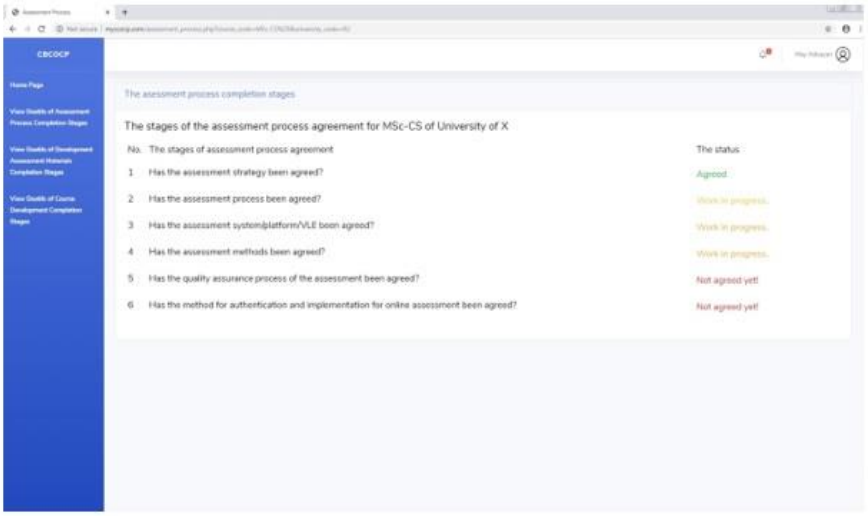

Figure 3. The status for each stage

2.2 Viewing the details of each stage

A member user can select the course 'X'. Then he/she can select from the navigation bar the "View Details" for more information about stages for: assessment processes, development of assessment materials and course development. The prototype shows the details including each stage name with status, and the status date and time agreed on documentation for policy and regulation, etc. (see figure 4)

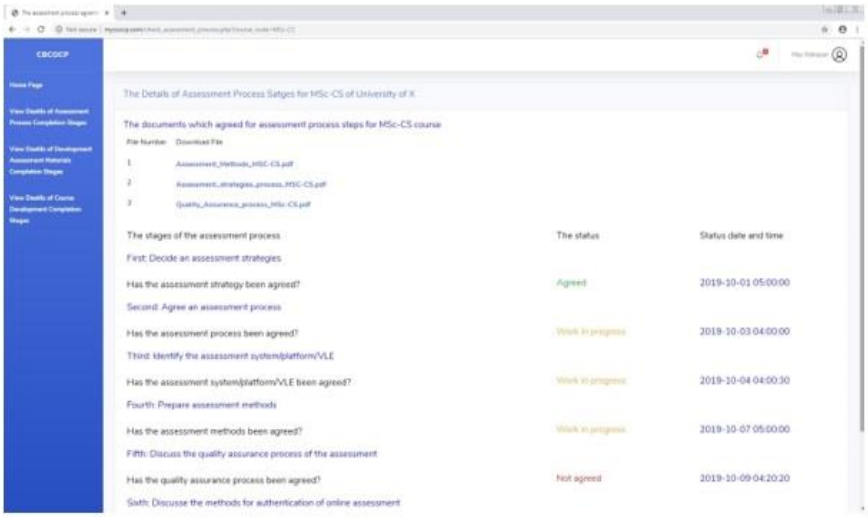

Figure 4. View Details for assessment process completion stages

2.3 Editing the status

A course administrator has the rights to edit details of the courses. For example, changing the status for each stage from "not agreed" to "working in progress" or "agreed" and from "working in progress" to "not agree" or "agreed". The prototype will be updated, and the date and time for each updated status are added automatically (see figure 5).

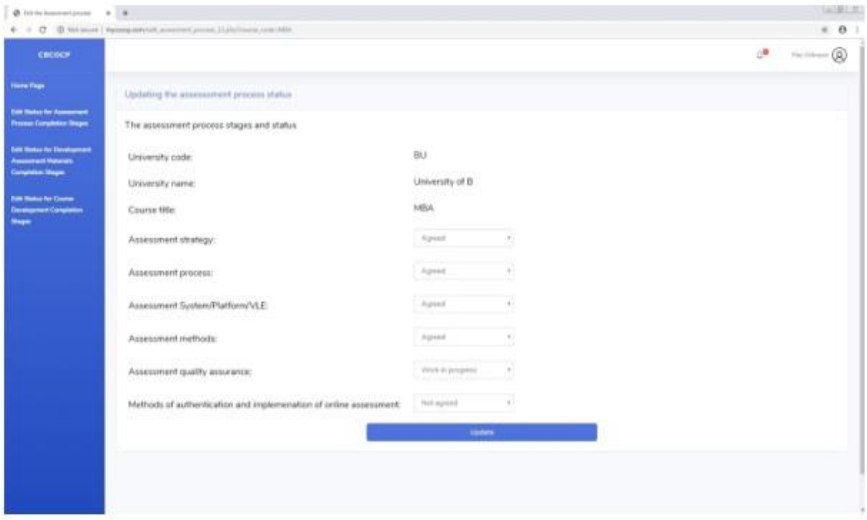

Figure 5. Edit status for assessment process completion stages

Then the prototype will send a notification message to all the members who are involved in the collaboration. Users can press on the message and direct them to the notification history page (see figure 6).

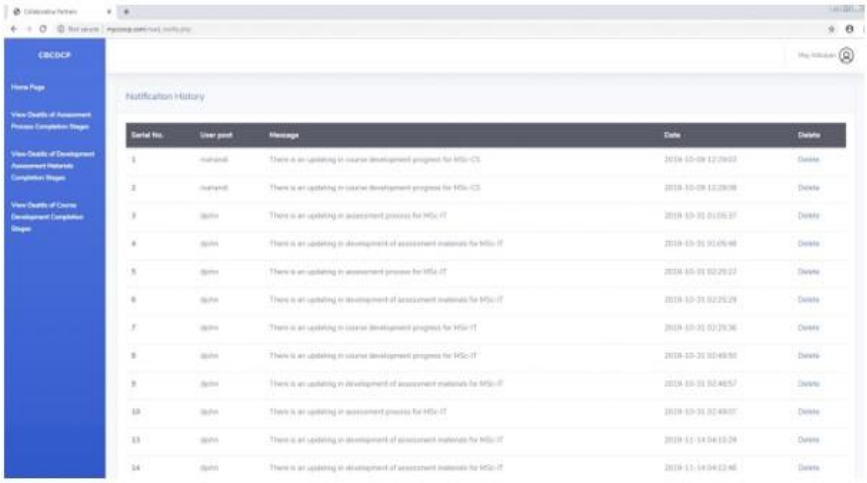

Figure 6. Notification history page