


Chapter 4

Curriculum Redesign for Cloud Computing to Enhance Social Justice and Intercultural Development in Higher Education

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ABSTRACT

As a result of the COVID-19 pandemic, teaching on a Cloud Computing module with more than 100 students based in different locations was moved online. In order to maintain student engagement, Cloud Computing had to be redesigned to be more adaptable for both online and in-person instruction. These changes should result in improved social justice and intercultural development. In this chapter, the authors present a case study of curriculum redesign showing how the Cloud Computing module has been updated to improve student engagement and employability while learning in multicultural environment. They have followed the professional frameworks to design intended learning outcomes associated with a usual student in terms of academic content, graduate attributes, and disciplinary skills. The teaching and learning profile has been redesigned by adapting teaching methods and resources for online and in person delivery to promote social justice and enable intercultural development. Assessment, feedback, and evaluation design were also considered as integral components of the curriculum redesign process.

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INTRODUCTION

The UK Professional Standards Framework (UKPSF) offers a platform for the practical development of teaching and learning professionals to better support students in higher education (QAA, 2018). It is helping new lecturers actively engage with academic tasks related to their teaching and assessments (Qadir, 2020). The current assessment procedure and feedback experiences help academicians for effective curriculum development to provide quality education (Brooman, 2011). The UKPSF can be used to support academics to develop their practice across the broad ‘Areas of Activity’ defined in the framework, including curriculum design (Gourdin, 2020).

The main aim of this research work is to analyse the redesign of the curriculum of Cloud Computing module at Queen Mary University of London (QMUL) to enhance social justice which teaching higher education in multicultural environment (Gill et al., 2022). The following case study of curriculum redesign was developed through a taught programme (Postgraduate Certificate in Academic Practice) which is aligned to the UKPSF and accredited by Advance Higher Education (HE). Cloud Computing is a Level 7 module at QMUL within MSc taught programmes such as Big Data Science, Artificial Intelligence, Computing and Information Systems, Internet of Things (IoT) and Computer Science. This module is one of four optional modules in the second semester of the MSc. This module is also available for part-time students in the second semester of the first/second year. Cloud Computing is worth 15 credits and builds on the multithreading programming concepts learnt in the Operating Systems and Python Programming modules. As a result of the COVID-19 pandemic, the entire module was moved online for a cohort of more than 100 students sitting in different countries. Therefore, the module was redesigned to adapt it for both online and in-person teaching with a multicultural and highly diverse cohort. The redesign further sought to enhance social justice and intercultural development in higher education. Social justice in higher education refers to a motivation to overcome social, cultural, and physical inequities placed on learners or students as a result of any uneven allocation of resources, and privilege (Parson, & Ozaki, 2020).

Motivation and Contributions

We have redesigned the curriculum for the cloud computing module to promote cross-cultural understanding among students. It is critical to take into account essential ideals of social justice, such as equality of opportunity, fairness, diversity, and participation, as well as human rights (Bull, 2008). Further, this redesign work shows how delivery of higher education can provide “practice of freedom” for students to learn to critically analyse and discover how to participate in the transformation of their worlds by promoting multiculturalism while working in group-based coursework (Naeem et al., 2022). The curriculum redesign of the cloud computing module shows the growing interest of students in assessment which is an innovative way to support more equal and rightful practices of evaluation and solves the equalities issues in assessment by incorporating the team work based group project activity (Gill et al., 2022). Every student has the option of joining a team of their own choosing in a team work activity. All students will receive equal guidance and support in order to understand this concept while working independently and in a team during the think-pair-share activity for completing the group project (Letizia, 2016). We have introduced fundamental key changes and innovations in teaching and learning, assessment or feedback and evaluation strategies during the redesign of cloud computing module to reduce the gap between traditional and non-traditional students and improve the student participation,

engagement and employability. A written exam, a lab quiz, and a group project were all included in the redesign of the module's summative evaluations. Students were also given three opportunities to submit feedback, including a Google form survey following each online session, QMPlus-based mid-module & final feedback, and two Mentimeter quizzes performed during online sessions. We have adopted various global frameworks for HE qualifications (as discussed in third section) to offer important components of social justice such as equality, participation and access to the module resources. The utilization of latest technologies (Mentimeter or Kahoot based online quizzes) for summative and formative assessments increases students' engagement, participation and learning in intercultural environment (Singhal et al., 2021).

The rest of the sections are structured as follows: Second section presents the review of literature. Third section gives the details of the curriculum redesign including the description and aims of the cloud computing module. Fourth section gives the wider contexts for the module. Fifth section presents the details of evaluation and quality assurance. Sixth section shows the preliminary results from the redesign. Finally, seventh section concludes the chapter and offers recommendations for future readers.

BACKGROUND AND ANALYSIS OF LITERATURE

In this section, various recent and relevant research works have been discussed to support the methodological considerations of this case study for understanding the considered research actions and decision-making processes in this work. A variety of theoretical resources for curriculum and pedagogy redesign were used in the work proposed by (Hattam, 2009) to establish ideas in order to disrupt the reproduction of inequality and promote social justice in multicultural environment. In a study (Walton, 2017), Utah State University's Technical Communication course was redesigned to include social justice principles across the curriculum. This work shows how an in-depth look at pedagogical research inspires a curricular redesign to promote social justice. Teaching methods after curriculum redesign included focusing on social justice as an primary theme; integrating real-world experience into the curriculum to enable team work; and providing ample opportunity for students and teachers to discuss concepts through drop-in sessions. The study also identified that student participation in multicultural environments can be improved through a variety of methods, including a launch meeting, collaborative assignment design, and the creation of a table detailing tasks and due dates. This is a good example for future teachers who want to include social justice efforts into their programmes to improve student participation and engagement.

A further study examines several ideologies, activities, and themes that are useful for redesigning the curriculum that engage students in addressing social issues while learning in a multicultural environment (Santone, 2018). This work shows that considering social justice and sustainability issues in project-based teaching methods can improve student participation and engagement while dealing with diversity. Literature (Peterson, 2016 and Meletiadou, 2022) reported that there is a need to consider important components such as employability, group project based teamwork, dealing with diversity, student's engagement and participation to enhance social justice and enable intercultural development. Therefore, we have considered the various proven teaching methods and types of assessments and feedback practices from the literature to redesign this Cloud Computing module.

A THEORETICAL FRAMEWORK FOR CURRICULUM REDESIGN

This redesigned module teaches cloud applications, advanced technologies, and security & privacy mechanisms. Advanced topics including microservices, IoT, edge/fog computing and Serverless architecture are taught, and the updated syllabus is as per research trends. Various levels of Bloom's taxonomy (Masapanta-Carrión & Velázquez-Iturbide, 2018) are used to offer interactive and group based activities during the delivery of module to support student engagement. Lab exercises have been redesigned based on the latest tools and techniques to help students upgrade their knowledge as per the industry's latest standards. In the module, a teamwork activity will allow students to work in groups to complete their project and develop teamwork skills that are essential for professional success, which leads to enhanced social justice and enables intercultural development. Further, the module allows students to complete various online courses and certifications on these technologies providing opportunities to encourage students to participate in online competitions, do MSc projects, join internships/PhDs and open doors to job opportunities. Student engagement is increased as a result of the redesign of the module, which also provides a platform for students to develop employability and collaboration skills while working in a group on a project. Furthermore, it assists students in developing communication and coordination skills necessary for managing project assignments and meeting strict deadlines, as well as learning to work autonomously, which also promotes inclusivity skills and social justice.

Module Description

The redesigned cloud computing module develops fundamental concepts. It advances the tools and technologies that have quickly changed computing's face and understand research trends. This module introduces cloud architectures and applications, virtualisation, RESTful API design, storage management, security & privacy-based cloud service and advanced topics including microservices and edge/fog/Serverless computing. The redesigned lab exercise will enable students to get hands-on experience using Amazon cloud. The redesigned assessments such as lab quizzes and coursework (group-based mini-project) support development of teamwork and employability skills to promote social justice and inclusivity. In the mini-project, each group has to develop a cloud application using technical skills learnt in this module.

Aims

The module aims to establish fundamental knowledge of cloud computing and identify its current status within computing research (Gill et al. 2022a). It will enable students to explore well-established privacy and security mechanisms, cloud technologies, including parallelism and virtualisation and their evolution & adoption by tech companies. Further, it uncovers the main reasons for the successful utilisation of cloud technology. It will empower the students to study important aspects, including cloud economics and service sustainability, to understand the impact of cloud technology on the economy and environment. This module will help the students to learn the technical skills and software tools and demonstrate the ability to develop a cloud application using Amazon Web Services (AWS) cloud in a team to gain hands-on experience and understand the spirit of teamwork.

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Table 1. The Intended Learning Outcomes (ILO) for Cloud Computing

Academic Content: by the end of the module students will be able to:	<ol style="list-style-type: none"> 1. Explain the fundamental concepts of cloud, including: <ol style="list-style-type: none"> a. Cloud service models b. Cloud computing drivers c. Virtualisation d. Datacentres e. Scalability f. Elasticity g. Web Services h. Microservices 2. Describe what Internet addressing, and Content Delivery Networks (CDNs) are and how to be used. 3. Demonstrate understanding of the concept of client-server architecture and message-driven communications. 4. Create a Virtual Machine (VM) in the AWS Platform, which demonstrates understanding the use of VM to serve a static HTML page. 5. List what is needed to deploy a RESTful application with Flask. 6. Study security mechanisms and cloud data management systems. 7. Give an introduction to advanced topics such as Edge, Fog and Serverless Computing.
Disciplinary Skills: by the end of the module students will be able to:	<ol style="list-style-type: none"> 1. Apply academic module content to gain hands-on experience for managing web services using AWS cloud. 2. Acquire the technical ability to run cloud services using Kubernetes and Cassandra in Docker. 3. Develop Python programming abilities to deploy a RESTful web application using Flask. 4. Study the use of REST APIs with authentication and data management mechanisms. 5. Develop the ability to work in a team by creating a cloud application using RESTful API service on AWS cloud.
Graduate Attributes: by the end of the module students will have be able to:	<ol style="list-style-type: none"> 1. Review some concepts from Operating Systems and VMs through a set of lab exercises. 2. Explain the representation of RESTful applications using XML and JSON. 3. Study the performance metrics and accounting technologies in cloud computing. 4. Discuss the economic considerations and ethics such as sustainability and privacy. 5. Acquire an awareness of current trends related to cloud technology for business management. 6. Acquire an employability skills while working in a team for group project. 7. Develop teamwork skills through group-based coursework to enable social justice. 8. Develop communication and coordination skills to manage project tasks to promote intercultural communication. 9. Learn to work independently, which would be helpful to make future project planning.

Intended Learning Outcomes

The Intended Learning Outcomes (ILO) for Cloud Computing are designed by following the “Frameworks for Higher Education Qualifications (FHEQ)” of UK degree-awarding Bodies (2014) and the Quality Assurance Agency (QAA) benchmark statements (QAA, 2018) “*Computing (2019)*” and “*Engineering (2020)*”. The “South East Coastal Communities (SECC) Credit Level Descriptors for Higher Education (2016)” and QMUL Statement of Graduate Attributes have also been used to inform the module’s ILOs. The ILOs of this module are shown in Table 1, which are pitched at the level of an average student in order to be more inclusive (QAA, 2018).

We have categorized different ILOs into three different categories: academic content, disciplinary skills and attributes. In academic content, we have discussed the important concepts considered while redesigning the syllabus of cloud computing. We have included the practical implementation of cloud computing such as RESTful API service for AWS Cloud through Python programming through the disciplinary skills (Gill et al. 2022a). After the completion of this module, students should have developed various attributes including teamwork skills, intercultural development, employability skills, communication skills. The list of highly recommended resources for the cloud computing module are given in *Additional Reading*.

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Table 2. Teaching and learning profile

Learning Plan	Module specific breakdown	Hours
Interaction of student and lecturer including lectures and lab sessions.	<ul style="list-style-type: none"> • Twelve Lectures (two hours each) = 24 hours • Twelve Lab sessions (two hours each) = 24 hours 	48
Peer Learning	<ul style="list-style-type: none"> • Five Drop-in Sessions (2 hours each) = 10 • Two hours/week for coursework (group-based mini-project) = 24 	34
Self-study and reflection	<ul style="list-style-type: none"> • Self-study (2 hours for each week) = 24 hours • One hour essential reading for each lecture = 12 hours • One hour post-reading and answering review questions for each week = 12 hours • Ten lab quiz (2 hours for every quiz including preparation and attempt) = 20 hours 	68
Total national study hours (including lectures, labs, assignments and assessments)		150

Teaching and Learning Profile

Table 2 shows the teaching and learning profile for cloud computing module after the redesign, which includes classroom learning, lab sessions, peer learning and self-study. The learning plan includes a total of 150 hours, the majority of which are invested on student and teacher interaction in the form of lectures and labs, peer learning through discussion in drop-in sessions and group-based mini projects, and self-study (attempting individual quizzes and interacting with QMPlus based Q/A).

Teaching Methodology

Improved student engagement, participation and learning in multicultural environment at QMUL are main focuses of the redesign to offer important components of social justice such as equality, participation and access to the module resources. This is achieved by using flipped classroom and online teaching, an approach which has been successfully applied and verified in legal education (Brooman, 2011). This module was led and delivered by a lecturer and four senior demonstrators who will organise and run the labs. All teaching staff are cloud experts. This module has 12 weekly sessions each 2 hours long, followed by a 2 hour lab session, which gives students an excellent opportunity to apply learnt concepts while performing experiments on Amazon AWS (Lage, 2000). Demonstrators support the students in their lab exercises, making lab sessions highly interactive. This is an effective approach for online and blended learning, as shown in microbiology teaching (Sancho, 2000). The use of various levels of Bloom's taxonomy (Figure 1) utilises the resources effectively to cover required activities and achieve ILOs. Bloom's Taxonomy is a fruitful technique to improve critical thinking and solve real-life problems with creativity in science and engineering disciplines (Hager et al., (1994) and Sosniak, (1994)). The various levels of Bloom's Taxonomy provide crucial components of social justice, such as equality, participation, and access to the module resources (Ford & Scott, 2021). Drawing inspiration from research which demonstrated the successful utilisation of Bloom's Taxonomy's for teaching sustainability (Pappas et al, 2013), we decided to utilise the same technique in Cloud Computing. Further, Bloom's Taxonomy has also been used within music education and was demonstrated to improve forward-thinking for the development of cognitive learning (Hanna, 2007). According to the research (Masapanta-Carrión & Velázquez-Iturbide,

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Figure 1. Application of Levels of Bloom's Taxonomy in Cloud Computing Module

Remember	<ul style="list-style-type: none">• Recall the existing/basic concepts based on suggested reading and interactive videos.• Recognise the concepts using the Mentimeter quiz during the lecture.
Understand	<ul style="list-style-type: none">• Discuss the concepts of cloud computing with an adequate case study and appropriate example during the lecture.• Review the recommended research article(s) after the lecture for better understanding.
Apply	<ul style="list-style-type: none">• Acquire required skills to use new tools.• Apply learnt concepts to learn technology(s).• Practice weekly lab exercise.
Analyse	<ul style="list-style-type: none">• Diagnose the errors that occurred while practising exercises.• Analyse the existing mini-projects in a team using think pair and share activity.
Evaluate	<ul style="list-style-type: none">• Select the domain/area/programming language for the mini-project.• Evaluate the learnt knowledge via lab quiz.
Create	<ul style="list-style-type: none">• Generate a new/innovative idea for a mini-project.• Develop a Cloud application in a team as a mini-project

2018), Bloom's taxonomy has been utilised primarily in programming courses for Computer Science Education, with the purpose of evaluating participants' performance being the main objective.

Students will be supported to achieve the first two lower levels (**Remember and Understand**) of Bloom's taxonomy to enable them to discuss fundamental concepts mainly through the lectures and associated preparation activities. The participants need to read the suggested articles and watch the interactive videos to activate their prior knowledge. Mentimeter quizzes will test their understanding at the starting of lectures, a technique which has been successfully applied in teaching political science. In class, the explanation of cloud computing concepts would be done using case studies and appropriate examples, an approach which has been successfully used in teaching history (Yousef, 2014). After each session, every student should write the answers to two questions on QMPlus. Demonstrators will support the development of the third level of Bloom's taxonomy during the lab sessions while students have the opportunity to practice lab exercises, enabling engagement with the latest software tools and cloud technologies, including Amazon Web Services (AWS) (**Apply**).

During the lab, demonstrators will help students diagnose errors while practising exercises, making lab sessions very interactive. The labs can take place online using MS Teams, where demonstrators are uploading the recorded video for each lab demonstration in advance (**Analyse**). Further, three different meeting are occurring at a same time: 1) first meeting for the students who are doing current lab exercise, 2) second meeting for the students who are doing last exercise and 3) third meeting for the students who have doubts or doing coursework (group-based project). The design of ten lab quizzes for independent learning is based on different lab exercises to test their knowledge (**Evaluate**). For this activity, every student has to spend two hours for ten weeks to learn the required skills for a lab quiz. Further, students need to do self-study each week to remember and understand key concepts (Suzuki, 2018). Activities such as pre-session reading, post-session reading, lab quizzes, and self-study improve students' independent learning.

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The group project activity supports students to achieve the higher two levels of the taxonomy. There were five drop-in sessions (2 hours each) in week 2,4,5,8 and 11 to improve peer learning as verified successfully in teaching literature (Adam, 2011). The first drop-in session (week 2) was offered the opportunity for students to ask their doubts. The introduction about coursework will be given in the week 4 drop-in session and provide guidelines for group members' selection. This session helped explain the importance of a group project (Junco, 2012), which improves teamwork skills as demonstrated in multi-variable calculus learning (Kashefi, 2012). Various concepts such as teamwork, employable real-world applications, and making working groups would be discussed in the session.

Further, students had the opportunity to discuss their project ideas and other mini-project queries in the week 5 drop-in session. Some students have a non-computer science background, so were advised to join a group so that they can learn both technical and teamwork skills with the help of other group members who have a strong computing background. Further, students analysed the existing mini-projects in a team using a think-pair-share activity, which can be an essential resource for completing group projects (Kashefi, 2012). Students selected the domain/area/programming language for a mini-project in their group (**Evaluate**). The week 8 drop-in session helped students show their progress and get constructive feedback. Finally, the week 11 drop-in session was organised to provide general support regarding exam questions or repeating particular concepts. Students also received continuous feedback about the mini-project, through interactive technologies, summative and formative assessments and lab quizzes. Other than drop-in sessions, every group had to spend two hours/week for coursework to complete their allocated tasks. In this project, the group had to generate an innovative idea based on their group discussion and knowledge of existing projects to develop a cloud application (Hoegl & Parboteeah, 2007). Further, the group needed to demonstrate the project in either synchronous or asynchronous mode (**Create**). This structured method enabled students to develop their knowledge and understanding of cloud computing gradually over the course of the module, and through a variety of activities in order to achieve the highest level of Bloom's taxonomy (Stanny, 2016).

The planned learning activities, interactive technology, learning resources (Mentimeter quiz, case study, interactive video, and think-pair-share) were used to improve students' skills and knowledge in an organised manner using Bloom's Taxonomy to achieve the module ILOs. Overall, the effective use of various levels of Bloom's taxonomy will encourage teamwork, alongside a range of other employability skills, and help students to learn advanced technical skills. The redesign of this module demonstrates how the ILOs will build the future of the students. Further, the curriculum redesign enhances social justice and enables intercultural development by focusing on important factors such as "employability", "group projects based teamwork", "dealing with diversity" and "student's engagement and participation".

Assessment and Feedback

Table 3 shows the key changes and innovations in teaching and learning, assessment or feedback and evaluation strategies during the redesign of cloud computing module. Previously, this module was intended to be taught face-to-face, and as such, it consisted of just two summative examinations (a written exam and an individual lab viva), as well as the conventional technique of gathering student feedback using QMPlus at the conclusion of the semester (Gill et al., 2022). Because of the COVID-19 pandemic, classes had to be moved online instead of being held in-person. This led to the need to use a wide variety of active learning strategies in order to educate more than one hundred students who are located in various locations while still preserving student engagement and employability along with social justice (Singhal

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Table 3. Description of Assessment and feedback

Criteria	Before Redesign	After Redesign
Teaching and Learning Mode	Face to Face	Both Face to Face and Online
Assessment	Summative Assessment 1. Written Exam (85%) 2. Individual Lab Viva (15%)	1. Summative Assessment 1.1 Written Exam 1.2 Lab Quiz 1.3 Group Project 2. Formative Assessment (every week) 2.1 Mentimeter Quiz 1 2.2 Mentimeter Quiz 2
Feedback	Final QMPlus Feedback	1. Google form Survey 2. Mid Module QMPlus Feedback 3. Final QMPlus Feedback
Evaluation Strategies	1. Written Exam (85%) 2. Individual Lab Viva (15%)	1. Written exam (50%) 2. Ten individual lab quiz (3% each) = 30% 3. Group Project (20%) 3.1 Problem Definition (5%) 3.2. Project Manual (5%) 3.3. Demonstration (10%)

et al., 2021). There is an urgent need to revamp the cloud computing module in such a way that, in the not too distant future, it can also be implemented in the current education systems (Naeem et al., 2022).

During the process of redesigning the module, we incorporated three distinct summative assessments: a written exam, a lab quiz, and a group project. In addition, we provided students with three different opportunities to provide feedback, including a Google form survey following each online session, QMPlus-based mid-module and final feedback, and additional formative assessment in the form of two Mentimeter quizzes taken during online sessions. The newly conceived evaluation profile for the cloud computing module is presented in Table 4. Every evaluation has had its duration, weighting, and minimum qualifying marks taken into consideration. In order to ensure that students are adequately prepared for both the written exam and the lab quizzes, we have assigned qualifying marks. In addition, we included a written exam as the last component of the evaluation to ensure that every student is assessed on their level of understanding of the fundamentals of cloud computing (Naeem et al., 2022). The redesigned cloud computing module provides equitable access and involvement in a variety of above-mentioned assessment, feedback, and evaluation strategies.

Assessment Design

This module has been redesigned with four assessments which includes both formative and summative assessments. Figure 2 shows the timeline for evaluations. The plan for the assessment is as:

- *Assessment 1 (A1)*: This is a **formative assessment**, and there will be two Mentimeter quizzes (MQ) in every weekly session (quiz-1 at starting the lecture and quiz-2 will be at the end).
- *Assessment 2 (A2)*: Lab quiz (30%) is a **summative assessment**, and every student has to perform lab exercise in week 2-11 and attempt a quiz after every lab. Every lab quiz has a weightage of 3%.

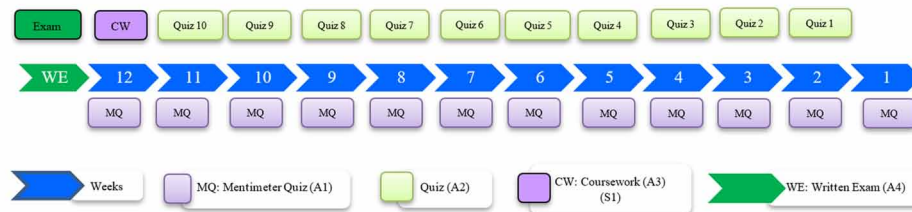
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Table 4. Assessment Profile

Assessment Description	Assessment Type	Duration	Weightage (%)	Final Element of Assessment?	Qualifying Marks (%)
Week 2-11: Summative Lab Quiz	Online lab quiz (5 questions) on QMPlus for week 2-11 (total 10 quizzes of 3% weightage each)	10 minutes each	30	No	50
Week 1-12: Formative Mentimeter Quiz	Two Mentimeter Quiz during lecture (starting and ending of the session)	5 minutes each	0	NA	NA
Week 12: Summative Coursework	Group-based mini-project (maximum 5 members in each group)	45 days	20	No	NA
Summative Written Exam	Final Exam	2 hours	50	Yes	50

- *Assessment 3 (A3):* Group Project (20%) is **summative**. Every group has to submit one project report then demonstrate it. The total marks of the project are divided into three categories: problem definition (5%), project manual (5%) and demonstration (10%).
- *Assessment 4 (A4):* Final written exam (50%) is a **summative assessment**, which will be held at the end of the semester.

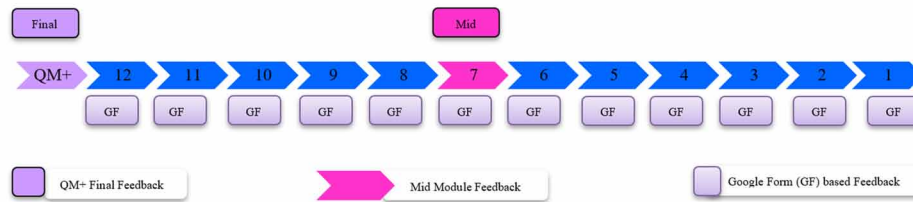
Figure 2. Timeline for Assessments



The assessments have been designed very carefully to fulfil the planned ILOs, and to give equal opportunities to students with diverse needs and different educational backgrounds (Testa & Egan, 2014). All the lecture recordings with subtitles, PowerPoint slides, interactive videos and related articles will be provided in advance, and all these resources are in line with the British Dyslexia Association (BDA) to assist students with dyslexia (Shaw & Anderson, 2017). Three types of summative assessments have been designed to enable different learning styles as tested successfully in teaching psychology (Hoegl & Gemuenden, 2001). Group-based coursework develops teamwork skills, while lab quizzes allow individual learning, which increases student engagement and participation. When students demonstrate their project by using presentations, also showing live execution of code with outcomes, this can help to reduce their anxiety and enhance their presentation/communication skills for employability. Working in a team on this project will also strengthen students’ problem-solving skills, intercultural communication and collaboration skills (Kashefi, 2012).

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Figure 3. Timeline for Feedback



Assessments A1 and A4 were designed to measure the knowledge of the students' academic ILOs (as specified in section 4). Assessment A1 is a formative assessment through two Mentimeter quizzes in every lecture. Students participate in Quiz 1 at the starting of the session to test their prior knowledge and join Quiz 2 at the end of the session to show their understanding of the current session. This assessment asks students to develop knowledge about every session and build up a connection between consecutive sessions (Brooman, 2011). Assessment A4 is a written exam that contains logical questions to test participant's subjective knowledge. Further, Assessment A4 is also used to measure the understanding of disciplinary ILOs (3,5) and attributes ILOs (2,4,5).

Assessment A2 (lab-quiz) and A3 (coursework) were created to assess the participants' understanding of disciplinary ILOs (1,2,4). Assessment A2 is a summative assessment in which students have to attempt a lab quiz from week 2 to 11 to evaluate their learning skills. Assessment A3 is a summative coursework assessment to assess participant's teamwork skills in addition to academic content (Kashefi., 2012). In this piece of coursework, a group of students select their mini-project domain and develop a new cloud application, which is aligned to the top level of Bloom's taxonomy. Further, students can improve their problem-solving skills through Assessment A3 as discussed above. Assessments A1 and A2 also assess understanding of attributes (1,3) as specified in earlier section. The different weights were assigned to A2, A3 and A4 based on the amount of work needed to complete it and to make the assessment regime as inclusive as possible for students. The module assessment avoids single high stakes assessments, offering instead a range of low and medium stakes tasks which are spread across the duration of the module.

Feedback Profile and Rationale

A traffic Light Model (start-stop-continue) is used to improve teaching practice based on student's feedback (Quesel, 2020). There are two types of feedback:

- At the end of every session, students have to fill out a survey using Google form (some of the examples are given in fifth section).
- There will be a mid-module and final feedback from the students on QMPlus (as discussed in sixth section). Figure 3 shows the timeline for feedback.

This feedback and formative assessment A1 are used to improve future teaching practices to enhance student engagement (Hoegl & Gemuenden, 2001) and give the students an excellent opportunity to prepare for the final exam.

WIDER CONTEXTS FOR THE MODULE

This module delivers a broad understanding of cloud computing as per the recent research advancements and develops the skills to use AWS cloud. Lab exercises are continually redesigned based on the latest tools/techniques to check students' knowledge as per tech companies' current standards (Gill et al. 2022a). The module team (lecture and demonstrators) are cloud experts, which benefits the students by integrating research-informed teaching. The addition of the teamwork activity enables students to undertake a group project and develop their teamworking, problem solving, presentation and communication skills, which are vital for enhancing employability, social justice and intercultural communication (Letizia, (2016), Hoegl & Gemuenden, (2001), Kashefi et al. (2012), Peterson et al. (2016)). Because the module makes use of the latest tools and techniques during lab sessions, it will also will improve students' research skills, which helps prepare them for roles such as game designer, software engineer, systems analyst, and applications developer.

Cloud Computing is an optional module for MSc programmes including Computing and Information Systems, IoT, Computer Science, Artificial Intelligence and Big-data Science, which draws on the multithreading principles learned in Operating Systems and Python programming. The ILOs and aims of Cloud Computing are well-aligned with the ILOs and aims of these programmes. Also, this module encourages all students to complete relevant Massive Open Online Courses (MOOCs), apply for internships or PhDs, as well as opening doors to career positions.

EVALUATION AND QUALITY ASSURANCE

The module's systematic evaluation helps assess the achievement of ILOs and the success of the teaching and learning design while promoting social justice for inclusive curriculum. We have evaluated the module in three different periods: 1) during the module delivery, 2) after completing the module and 3) feedback from alumni students based on their career progress.

For the first period, we used three evaluation methods while the module was running: i) Mentimeter quiz-based formative assessment, ii) Google survey and iii) Mid-module feedback. In every lecture, we used a Mentimeter quiz at the start to test the student's prior knowledge, and at the second quiz at the end tested understanding of the current session's material. The use of Mentimeter can increase student-lecturer interaction, especially during online teaching (Gill et al., 2022). Students can also evaluate their progress through these quizzes, and it permits progress towards ILOs to be evaluated instantly (Singhal et al., 2021).

Further, Google surveys were used to get anonymous feedback from the students regarding weekly content. In this feedback tool, we used the Traffic Light Model (start-stop-continue) to consider students' suggestions and enhance teaching practice and methodology (Quesel, et al., 2020). This period is instrumental in implementing reflective action for better student engagement (Nicol & Macfarlane-Dick, 2020). For example, if students are finding difficulty understanding one particular concept, this can be managed during the course by sharing more examples or case-studies. Finally, we used a mid-module feedback survey halfway through the module teaching to get a broader perspective of the module's effectiveness in terms of student satisfaction and values of social justice (Naeem et al., 2022). This feedback helped review student progress towards achieving ILOs. Those making weaker progress towards were identified and supported through lab sessions and coursework drop-in feedback sessions (Gill et al., 2022).

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For the second period, formal student survey feedback was used to evaluate the students' overall view about the module. Further, attendance and exam results (individual assessment grade and general grade) were considered. Other available data of participants (age, international status, gender) was analysed to check their progress during the module (Nicaise, 2006). Students' final results and attendance also helped to investigate the relationship among various parameters of feedback. Later, these parameters can be analysed to identify the areas of improvement if required. Different types of biases (gender disparity, gender-based confidence) can be found in feedback (Nicaise, 2006), which is difficult to consider for improving teaching practice but can be reviewed on an individual case-basis feedback to identify possible weaknesses.

For the third period, feedback from alumni students will be considered concerning their career progress in order to understand check how effective this module is in supporting students with employability (Naeem et al., 2022). This feedback will be collected through alumni connections and help determine the critical weaknesses for stakeholders; for example, if a student uses outdated tools/technologies for their lab exercises or coursework, this could be updated to increase future students' employability. Further, we will also consider the feedback from peers/colleagues to better redesign the module as per their successful experience to ensure the development of inclusive curriculum.

PRELIMINARY RESULTS FROM THE REDESIGN: DATA ANALYSIS AND FINDINGS

In this section, we highlight some conclusions and findings in the form of feedback and formative assessments.

Formative Assessments

For formative assessments, two Mentimeter quizzes were used at the start and end of online session and every quiz contains two MCQ or T/F questions. The first quiz checks the students' prior knowledge, while the second quiz reviews students' understanding. There were 168 students studying Cloud Computing for the year 2020-2021 at QMUL. Table 5 shows the Mentimeter based weekly online quizzes (MCQ and T/F) during online session (Formative assessment). Table 5 clearly shows that 117 students out of 168 have participated in the Mentimeter quiz in the first week online session, which clearly shows that using web-based tools are increasing student engagement during online learning. It is noted, however, that the number of participants decreases with time and only 42 students participated in the last week.

Feedback

For employability and social justice, we are sharing only students' anonymous views on this at this stage of course from mid-module and final feedback. Google survey based mid-module feedback was collected on a scale of 1-5. In this feedback very less students have participated and we got very good satisfaction rate, which shows that students are enjoying the online learning for cloud computing. Students found this is a well-structured course that includes Mentimeter quizzes, interactive laboratories, and lectures with Mentimeter quizzes. But one student wants less quizzes, sometimes we have to be careful with the content. The majority of students expressed satisfaction with the use of a variety of active learning

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Table 5. Mentimeter Based Weekly online quizzes (MCQ and T/F) during online session (Formative)

Weeks/ Quizzes	Mentimeter Quiz 1 (at the start of session)					Mentimeter Quiz 2 (at the end of session)				
	No. of Participants	Q1		Q2		No. of Participants	Q1		Q2	
		Correct	Incorrect	Correct	Incorrect		Correct	Incorrect	Correct	Incorrect
Week 1	117	65	52	47	70	111	88	23	71	40
Week 2	80	59	21	65	15	75	61	14	55	20
Week 3	93	75	18	85	8	91	55	36	61	30
Week 4	77	61	16	68	9	81	57	24	68	13
Week 5	70	55	15	55	15	71	48	23	42	29
Week 6	72	61	11	53	19	56	46	10	41	15
Week 7	62	49	13	45	17	49	32	17	42	7
Week 8	75	52	23	46	29	41	22	19	28	13
Week 9	70	55	15	35	35	37	28	9	31	6
Week 10	59	42	17	42	17	39	25	14	25	14
Week 11	48	35	13	31	17	36	24	12	21	15
Week 12	42	22	20	32	10	18	15	3	12	6

technologies and tools in the delivery of this module. During the online sessions, students generally enjoyed the Mentimeter-based online quizzes and recognised them as one of the crucial tools to use in order to keep their attention during the online sessions. For the purpose of putting the principles that were learned into practise, we utilised Amazon Web Services (AWS)-based lab activities, each of which offers a real-time cloud environment (Gill et al. 2022a). Some of the students have provided a variety of suggestions to improve the continued delivery of the module. These suggestions included the use of video demonstrations of all of the lab exercises, revision sessions for labs as well, and a smaller number of students participating in each lab session. The next year, pre-recorded videos will be made accessible for all the lab tasks, and students will be able to begin working on them right away. We will conduct review sessions for laboratories during the reading week (week 7) and the final week (week 12) will give them the opportunity to complete any exercises which are still pending. We used Google form feedback at the end of the module to understand students’ perspective related to teamwork, employment and teaching practice which shows most of the students are satisfied with this teamwork activity for their career. Further, students mentioned that learnt recent tools and technologies in cloud computing module are useful for their career. Another feedback about the learning concepts shows that most of the students found it very useful for their employability. Final feedback of students about teaching practice shows that students are very happy with the teaching methodology used to teach through this module redesign.

Analysis

The above-discussed feedback and formative assessments and VLE analytics, is clearly showing that the changes made during redesigning of cloud computing module were successful both in terms of

“employability”, “group projects based teamwork (inclusivity)”, “dealing with diversity (social justice)” and “student’s engagement and participation”.

Positive Aspects of the Redesigning Module

The content has matured compared to the previous year (teaching cloud computing module in the year 2019-20), where substantial changes were made due to online learning. Overall, the provided content and lectures were more polished. Lab exercises and coursework are now based on a real cloud platform (AWS Cloud), which provides students with real hands-on experience (Gill et al. 2022a). The group project component made sure every student developed teamwork skills while working in a group. Every group has submitted their coursework on time and most of the students attempted lab quizzes before deadline. Some students have answered the review questions every week.

Negative Aspects of the Redesigning Module

Some students had very poor coordination for the group project (Suzuki, 2018). A small number of students did not engage with the lab quiz and saw their results affected (Quesel, 2020). There was a small but very noisy group of students with non-computer science background that systematically complained about the module being too technical and excessively difficult for them (Testa, & Egan, 2014). We organized 5 drop-in sessions for them but they some students did not listen to our explanations, and kept with this attitude until the end of the semester.

Overall feedback was very positive. The content is highly praised by most of the students, and considered to be very useful for their carrier. There were several criticisms to the group project as it is difficult to work in team due to online learning. We will consider various group project based successful case studies to implement again in the next year module by considering diversity in terms of of culture, nationality, educational background or experience, the age of students, ethnicity, race, and gender, internal disagreements or conflicts might emerge due to this greater diversity.

We have given the detailed analysis of the impact of the changes on students and their feedback. We will also consider the feedback given by students to analyse the impact of redesign on graduates’ careers when we will follow up with this approach in future.

CONCLUSIONS AND RECOMMENDATIONS

This study aims to improve social justice by re-designing the curriculum of Queen Mary University of London’s Cloud Computing course. It was also updated to be more adaptable for both online and in-person education in a diverse world, thereby making it more flexible. Among the goals of the redesign was the intention to make higher education more inclusive and to foster cross-cultural communication.

Upon reflection, we learned how to use constructive learning techniques to enhance teaching during the pandemic. We tried new teaching strategies that we learned in the year 2020 while teaching both face-to-face and online. We used the blended learning technique for cloud computing to foster prior experience by incorporating active learning activities such as interactive video, Mentimeter quiz, group-based project, and lab quiz. Overall, this course provided an excellent opportunity and platform to test inclusive teaching practices, which we identified based on the contemporaneous feedback during the

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module's delivery. We have included three evaluation methods to get inputs for different periods. We discussed these evaluation methods with other colleagues and they informed us that receiving continuous feedback during the module's delivery is very important to improve the teaching practices. Based on their suggestions and reflection, we kept all the evaluation methods to get feedback from different aspects.

We have extensive knowledge of cloud computing, particularly when it comes to applying cutting-edge and well-established research trends in the industry (Gill et al. 2022a). It is crucial to do research in the same field because there is a solid connection between teaching and research, which inspire participants towards cloud research (Feldon et al, 2011). Additionally, this will provide students with a brilliant chance to find a relevant mini-project subject for their class project. Further, it develops participants' intellectual ability to complete their mini-project on challenging ideas. Finally, this teaching methodology will benefit the students by learning cloud computing, getting research knowledge, and developing teamwork skills to complete coursework. In summary, this teaching methodology provides students who might not currently have social capital, connections, and networks with the opportunity for their professional development.

The goal of this study is to make higher education more relevant to students' activities outside of the classroom by implementing cloud computing reforms. Academic content, graduate attributes, and disciplinary skills are all included in the Intended Learning Outcomes (ILOs). Additionally, the teaching and learning profile has been revised to highlight the teaching techniques and materials that will be utilised to teach the cloud computing course.

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KEY TERMS AND DEFINITIONS

Cloud Computing: Pay-as-you-go IT resources are made available on-demand over the internet.

Curriculum Redesign: Excellent analysis of the skills modern students need to succeed in today's and the future society.

Formative Assessment: Monitor student learning to offer feedback that may be utilised by instructors to enhance their instruction as well as the student's learning, the purpose of formative assessment.

Intercultural Development: Building organisations and cultures that incorporate individuals from a wide range of socially defined groups, such as race, gender, ethnicity, nationality, and religion.

Learner: This word is used interchangeably with “student” and “participant.”

QMPLUS: It is the online learning environment (OLE) used across the university (Queen Mary University of London) and is based on Moodle.

Social Justice: The aims of social justice in education are to increase empathy, fairness, and equality.

Think-Pair-Share: Students work together to solve an issue or answer a question on a text they've been assigned.