Enhancing Student Learning, Engagement and Employment through Inclusive Curriculum Design

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The diverse student body at Queen Mary University of London requires an effective approach to ensure equal opportunity in higher education. This includes promoting equality, inclusion, equity, and access to services. To address this, we present a case study about a redesigned cloud computing module to enhance student engagement, employability, and intercultural learning. The module's learning outcomes are based on the students' graduate attributes and cross-disciplinary abilities, as defined by professional frameworks. To support equal opportunity and facilitate multicultural growth, we have updated the education and learning model to include innovative teaching methods and materials for efficient curriculum delivery. This study establishes the foundation for an action research review of cloud computing that aims to create an inclusive curriculum.

Keywords: Curriculum Redesign, Cloud Computing, Student Engagement, Employability, Higher Education, Inclusivity

INTRODUCTION

The COVID-19 pandemic prompted the relocation of classes to online platforms in the 2019–20 academic year (Singhal et al., 2020). Therefore, it required educators to revise the previous curriculum to make it more flexible for both in-person and online education, which is necessary to keep students engaged (Naeem et al., 2022). If we want to help learners from all over the world participate in multicultural development, we need to revamp the teaching and learning model to make it work better with both online and in-person delivery of course materials to meet the needs of the current education system (Gill et al., 2022). However, redesigning the curriculum cannot be completed without first addressing examination, feedback, and evaluation methods. So, there is a need to redesign the curriculum to increase the participation of students and promote job prospects in diverse educational settings, which will further enhance equity and multicultural integration in academic institutions around the globe.

Within the context of the COVID-19 pandemic, a comparable effect was observed at Queen Mary University of London (QMUL), a UK Russell Group University with a diverse and growing student body. Within the School of Electronic Engineering and Computer Science programmes are also seeing continued growth in the number of students enrolling and an increase in the diversity of students. To understand this, we have considered a case study of a redesigned curriculum and assessment that showcases how we revised the cloud computing module to enhance student engagement, employability, and intercultural learning.

The cloud computing module is offered as part of the Master of Science (MSc) in Computer Science and Big Data programmes within the school. In the years 2020–21, which coincide with the experiences of educators all throughout the sector during the COVID-19 pandemic, promoting student engagement has proven to be a challenging task for this particular module (Gill et al., 2022). Early findings from module evaluation showed that students were disconnected, reluctant, and not interested in attending in-person courses. In 2020, research showed that just 30% of participants completed and submitted their assignments on time while delivering this module in-person (Gill et al., 2023a). According to the students' feedback, completing the assignment individually is challenging and time-consuming. In addition, the assignment necessitated a high level of technological expertise, which not all students—including continuing students, software engineers, and professional cloud experts—possessed. Several alumni of our cloud computing course have spoken about how important it is to collaborate or work as a team to develop cutting-edge abilities that will serve them well in their future endeavours (Singhal et al., 2020). In order to help students succeed in their careers, it is necessary to improve their active engagement, participation, teamwork, and management abilities (Adam et al., 2011). Informal observations of practice and discussions with colleagues teaching comparable modules at other universities (such as Imperial College London, University of Birmingham, University of Glasgow, and the University of Melbourne) have determined this. In order to assess and enhance current practice within the QMUL module, empirical evidence must take into account a number of crucial factors, as illustrated in Figure 1. These include outcomes of evaluations, reflection logs, informal discussions with learners, focus groups, peer observations, and input from learners. The successful implementation of the proposed plan will contribute to the establishment of an inclusive framework for cloud computing education.

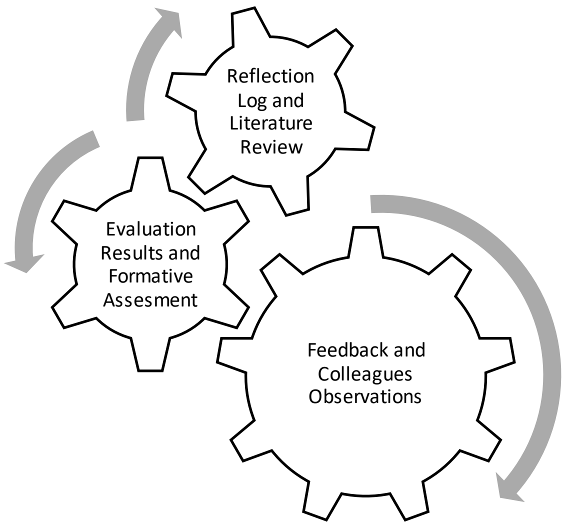

Figure 1: Important factors are considered for module redesign

Motivation and Contributions

Feedback about the career advancement of current students, graduates (who are working in cloud-based companies), and prominent academics from Imperial, Birmingham, and the University of Melbourne who are teaching cloud computing or distributed computing was considered in order to assess the effectiveness of this module in enhancing students' employability. For instance, if a student is using outdated tools or technology for lab exercises or assignments, this might be upgraded to make future students more marketable to potential employers (Ford et al., 2021). This input was gathered through alumni contacts and helped stakeholders identify important limitations. To support the design of an inclusive curriculum, we have considered the comments from colleagues and peers in order to adapt the module better based on their constructive experiences. In order to improve employability and teamwork skills, coursework centred on collaboration was developed with the help of industry professionals from CloudScalar UK, MH-IT & Service GmbH Berlin-Germany, and Microsoft USA. Working in a team creates an opportunity for students to collaborate with peers who may have varying levels of experience, perspectives, and cultural backgrounds (Hoegl & Gemuenden, 2007). Figure 2 has determined various major challenges based on student input, the evaluation results provided inferences, and the contribution of other stakeholders, motivating us to create an innovative research strategy for cloud computing and facilitate a sustainable education system for it. To tackle these challenges, a previous study was reviewed that determined how well a new interactive lab activity that relies on student teams may enhance the learning experience of cloud computing course participants (Serrano et al., 2019). Previous studies have explored the extent to which lab activities rely on student teams (Ryan & Tilbury, 2018). By taking this route, students can get the help they need from faculty, administrators, and other school and university members to advance in their chosen fields.

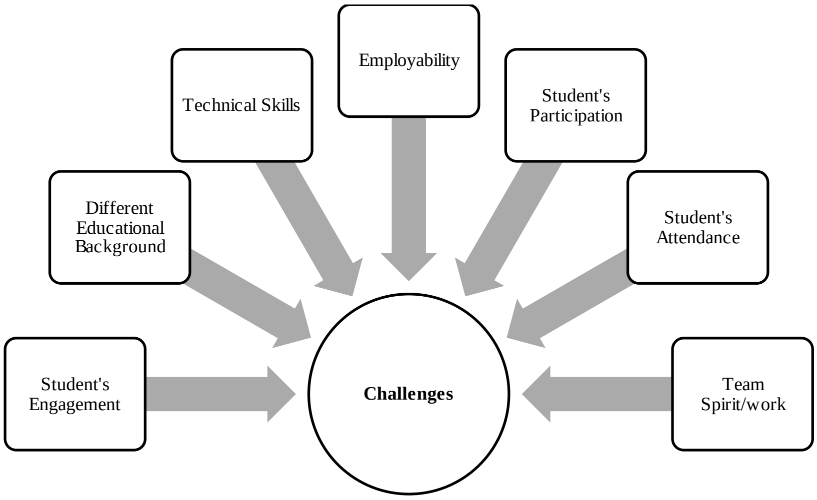

Figure 2: Practical obstacles of significance in facilitating a long-term educational environment for cloud computing

One of our goals in redesigning the curriculum of the cloud computing module was to help students better comprehend and value one another's cultural backgrounds. Fundamental principles of an equitable society include recognising the equality of all people, promoting inclusion, diversity, equity, and providing opportunities for everyone (Gill et al., 2023b). In addition, this redesigned course demonstrates how higher education delivery might offer students the *"practice of freedom"* they need to critically analyse and engage in changing their environments through multiculturalism promotion in group projects and so on (O'Brien et al., 2022). Redesigning the cloud computing module supports students engaging in assessment, which is a novel approach to promoting fair and equitable evaluation procedures and addressing assessment equity concerns through the integration of a group project centred on teamwork (Clifford & Montgomery, 2017). When it comes to group projects, each student gets to choose a team. Throughout the think-pair-share process that culminates in the group project, every student will get fair instruction and assistance in comprehending this idea, whether working alone or in a team. In order to narrow the achievement gap among students with different backgrounds and boost student engagement, performance, and employment prospects (Hager et al., 1994), we have implemented significant new approaches to instruction, evaluation, and measurement as part of the cloud computing module's redesign. For instance, while teaching online or in person, we have utilised various engagement strategies or methodologies to boost student engagement, such as web-based quizzes using Mentimeter or Kahoot during teaching to test the delivery of every lecture, teamwork-based group projects using think-pair-share activities, and H5P-based videos to activate prior knowledge. The new summative assessments for this module comprise a written test, a lab quiz, and a group project. In addition to two Mentimeter quizzes administered during live sessions and responses based on QMPLUS (the Moodle-based online learning environment that everyone at QMUL uses) at halfway and at the end of each module, students were provided with a *Google Form survey* after each session. The use of the newest tools for formative and summative evaluations, such as the Mentimeter or Kahoot-based web-based tests, enhances students' engagement, involvement, and learning in a multicultural environment (Parson & Ozaki, 2020).

ANALYSIS OF LITERATURE AND BACKGROUND

The present study provides the groundwork for our action plan, which will enable a cloud computing educational setting that is both online and designed for prolonged existence (Gill et al., 2023c). For instance, a mobile device-based interactive learning technique for e-learning was created throughout the COVID-19 pandemic (Singhal et al., 2021). Members of the research panel were faculty members from QMUL. Project completion was facilitated via collaborative efforts at the University of Petroleum and Energy Studies (UPES) in India. Using this strategy, the learning capacity of learners was enhanced, leading to a 66.9% rise in the mean score across two science and technology domains. In order to provide an endured digital classroom, we want to incorporate this strategy into our cloud computing course as a result of its success at an Indian university. Additionally, a group effort at Indiana University was investigated in an effort to raise students' engagement, focus, and interest (Cavinato et al., 2021). Students' motivation and interest in studying are increased through collaborative, hands-on learning activities, according to comments made by 6000 university students. Students' perceptions of the enhanced interactivity led to improvements in focus, attendance, technical skills, and beneficial relationships with peers. According to the findings, students have a better chance of succeeding when their deadlines are given greater flexibility. With this proof, we can improve the cloud computing module's participation and collaborative work. Research by Gunawan et al. (2017) examined the effects of online electrical current education on students' ability to solve problems and found that students benefited from having trained demonstrations to guide their lessons. This may be utilised for our empirical study project aimed at enhancing collaboration abilities. Cloud computing demonstrations will also have access to Amazon Web Services (AWS) cloud-based training through the AWS Programmes for science and education, which will help them learn more and prepare them for the future.

Participants in a nanomaterials programme were tested independently and in small groups using online labs (Gerstenhaber, & Har-El, 2021). Using online surveys and lab results, they determined how well the module worked for various socioeconomic and cultural backgrounds (Luse & Rursch, 2021). Based on student feedback, we know that our strategy for dealing with diversity will be most effective if we combine both team and individual efforts. In order to ensure that students fully grasp the key concepts before beginning the lab, we have prerecorded videos for each topic. The mental capacities utilised by participants during online physics projects were also recognised in a different investigation (Yusuf & Widyaningsih, 2020). Video clips of educational discussions and exams were used to qualitatively assess these abilities. Nearly all students (97.6%, to be exact) took advantage of the opportunity to test their knowledge in a fully-customisable online classroom. Their results show that taking a quiz once a week helps students relax and is good for their mental health and relationships. Therefore, we should include them in our study strategy to create a longer-lasting module (Hughes et al., 2020). Comparable to this one, a different study (Achuthan et al., 2017) evaluated other parts, including consciousness, sharing of knowledge, and causal thinking. Questions and answers were formatted as a questionnaire, and the assertions were categorised as true or false. The approach we choose can incorporate an H5P-based video-based pre-lab to encourage learners to participate. Input from 145 students in this research indicates that learning in a virtual environment is more effective than learning in a real lab and combining both learning components enhances critical thinking. Alternately, Gerstenhaber and Har-El (2021) investigate the possibility of using an online connectivity course to raise students' familiarity with “business” networking settings. At the most advanced stages in Bloom's taxonomy, this method seems to boost students' computational skills, which boosts their deliberate approach and ultimately allows them to come up with creative answers to the given challenge. In order to ensure the long-term viability of this teaching method, this research is useful for cloud computing learners as it teaches them how to use Bloom's taxonomy (Smith et al., 2021) to develop their technical abilities and come up with new ideas for group projects.

Critical Analysis of Literature

Learners interaction, involvement, presence, and efficiency in the online setting could be enhanced by incorporating various forms of feedback and formative assessments into the course delivery method. Some examples of this feedback include, on a weekly basis, survey responses and mid-module feedback. It is evident that we considered various sources of feedback, as well as summative and formative evaluations. A number of studies have shown that working together as a group is a crucial step in creating an engaging and long-lasting online learning atmosphere for students. Collaborative projects that apply the Problem-Based Learning (PBL) methodology can help students become more effective problem-solvers (Kapilan et al., 2021). One crucial aspect of a viable cloud computing educational setting is the effect of collaboration on students' engagement, presence, and productivity; yet, this aspect has not been adequately addressed in the existing research (Gill et al., 2023b). According to Gill et al. (2023c), no research has yet determined how learners' age, gender, ethnic origins, socioeconomic status, academic experience, and cultural background affect their professional ability to learn when working in teams. In addition, there are various methods of active learning that could be utilised for formative evaluations to enhance student engagement, including interactive videos using H5P, Internet-based tests, group discussion tasks, and interconnected debates and responses (Gerstenhaber, & Har-El, 2021; Hughes et al., 2020; Achuthan, & Murali, 2017; Achuthan et al., 2017). Also, according to the literature, it's really difficult to conduct several interactive lessons in large classrooms; doing so calls for careful time management and preparation (Gerstenhaber, & Har-El, 2021). On top of that, marking all of these tests takes a long time. The tutor's time and effort may be better utilised by integrating such tasks with e-learning systems like QMPLUS, which allows for quick marking. The lecturer's professional and personal growth can be enhanced by consistently using these instructional techniques. We were motivated to incorporate Mentimeter-based questions into the live session as a form of formative evaluation to boost student engagement. Learners will be better prepared to complete weekly summative assessments (quizzes) following each lab session (Geiger & Bostow, 1976). Students' classroom engagement and presence can be enhanced by administering quizzes based on Mentimeter (Gill et al., 2023a). The major reason for the absence of student participation in much of the aforementioned literature is that summative evaluations were mostly written examinations and individual projects. According to Gill et al. (2023b), students' engagement, involvement, participation, and achievement may be enhanced in an online setting through educational activities, including formative and summative evaluations. In order to create an environmentally friendly learning setting, this study plan incorporates findings from literature and research to enhance the learning experience for the cloud computing course.

NEW TEACHING FRAMEWORK FOR INCLUSIVE CURRICULUM DESIGN

This new teaching framework deals with the most concerning topics in higher education worldwide, i.e., student engagement, employability, inclusivity, equity, and the post-pandemic realities that push forward educational revolutions (Gill et al., 2023a). The redesigned curriculum covers cloud computing, cutting-edge technology, and privacy and security protocols (Gill et al., 2024b). The new curriculum reflects the latest developments in research and covers advanced subjects such as serverless architecture, the Internet of Things (IoT), edge and fog computing, and microservices (Gill et al., 2023c).

Module Description

The updated cloud computing module builds upon earlier work by expanding on core ideas of the such as learning about real-time cloud computing environments. It helps to comprehend the trends and progress in the tools and technology that have dramatically altered the computing landscape. Students will be able to gain practical experience with Google Cloud Platform (GCP) through the revamped lab activity (Gill et al., 2023d). In an effort to foster inclusion, the new lab tests and assignments (a group-based mini-project) encourage the growth of collaboration and employability abilities. As part of the mini-project, groups will apply what they've learned in this module to create cloud applications.

Aim of the Research

A new collaborative exercise to educate students about cloud computing will be introduced in accordance with QMUL Strategy 2030, which seeks to encourage inclusivity and improve students' job opportunities. This will allow them to work together on the project in a team, boosting their participation and collaborative abilities.

Professional Frameworks and Quality Assurance

According to the Quality Assurance Agency (QAA) benchmark statements (QAA, 2018), "Computing (2019)" and "Engineering (2020)" as well as the "Frameworks for Higher Education Qualifications (FHEQ)" of UK degree-awarding bodies (2014), the Intended Learning Outcomes (ILOs) for cloud computing is created. Additionally, the QMUL Statement of Graduate Attributes and the "South East Coastal Communities (SECC) Credit Level Descriptors for Higher Education (2016)" were respectively consulted in order to shape the ILOs of this course (Gill et al., 2023b & Gill et al., 2023b). In an effort to be easier to understand, the module's ILOs are written at a level typical of a typical student (QAA, 2018).

Bloom's Taxonomy

To keep students engaged during the module's delivery, we employ tasks based on Bloom's taxonomy at different levels to facilitate group work and interactive activities (Pappas et al., 2013). We observed that students benefit from using Bloom's Taxonomy to sharpen their critical thinking skills and find innovative solutions to real-world challenges (Stanny, 2016). The several levels of Bloom's Taxonomy provide essential elements of social justice, including equity, involvement, and accessibility to the module materials (Sosniak, 1994). Our decision to apply Bloom's Taxonomy to cloud computing was based on previous studies that showed how effective it is in educating sustainability (Masapanta-Carrión et al., 2018). In addition, research has shown that using Bloom's Taxonomy in music instruction can help students think more strategically about how to advance their cognitive learning (Mayhew, 2019). To ensure that students stay up-to-date on industry requirements, we have rebuilt lab activities using the most recent tools and approaches (Smith et al., 2021). Learners can work in groups to finish the module's project and hone their collaboration skills, which are crucial for future careers, improving social justice, and facilitating multicultural growth (Gunawan et al., 2017). In addition, the module gives students the chance to earn certificates and take online classes in these fields, which can help them land a job, get an internship, or even compete in online certifications. The revamped module not only offers students an opportunity to work on group projects but also boosts their engagement and gives them skills that are valuable in the job market (Quaye et al., 2019). Students learn to work independently, which promotes inclusion and equality for all (Nicaise et al., 2006), and they improve their interpersonal and teamwork skills, which are essential for managing projects and achieving tight deadlines.

Module Redesign and Teaching Methodology

The redesign of the cloud computing module at QMUL is mainly about making it easier for students to learn, participate, and get involved in a diverse environment (Testa & Egan, 2014). It also includes crucial elements of an equitable society, like fairness, involvement, and accessibility to module materials (Naeem et al., 2022). At QMUL, we are utilising a Virtual Learning Environment (VLE) for the purpose of designing an inclusive curriculum (Salmon et al., (2017). This VLE is particularly accommodating to learners with various learning styles, including those who study visually, audibly, and kinaesthetically (Kooijman et al., 2022). A lecturer and experienced demonstrators oversaw the laboratories and supervised and delivered this course. Each of the 12 weekly classes in this module lasts for 2 hours, and then there is a 2-hour lab class where students practice what they've learned by doing experiments on the GCP. The lab sessions were participatory since the demonstrators helped the students with their tasks. In order to accomplish ILOs and cover all necessary tasks, it was helpful to employ Bloom's taxonomy (Hanna, 2007) at different levels, as shown in Figure 3.

REMEMBER	• Recall concepts with H5P videos • Recognise fundamental concepts using the Mentimeter quiz
UNDERSTAND	• Explore a case study to illustrate key ideas • Review the recommended readings and answer the questions
APPLY	• Acquire Technical Skills with Demonstrator Videos • Apply and practice skills taught through lab exercises
ANALYSE	• Recognise errors committed during lab sessions • Discuss these errors in project teams or drop-ins
EVALUATE	• Choose the mini-project application to practise practical skills • Assess the student's knowledge through the lab quiz
CREATE	• Develop teamwork skills with a creative group project. • Create a cloud-based prototype to demonstrate new tech skills

Figure 3: Exploring Cloud Computing via the Lens of Bloom's Taxonomy

Throughout the classes and related preparatory tasks, students were helped to reach the first two levels **(Remember and Understand)** of Bloom's taxonomy, which allowed them to debate fundamental topics (Sosniak, 1994). In order to make use of what they already knew, participants read the recommended articles and viewed the interactive H5P videos (Nicol & Macfarlane-Dick, 2006). At the beginning of each class, instructors administrated Mentimeter quizzes to gauge students' level of comprehension (Yousef et al., 2014), as it is an effective method for teaching (Mayhew, 2019). In class, students learned about cloud computing through real-world applications and case studies (Suzuki et al., 2018). Each student used QMPLUS to record their responses to two questions after each class. Throughout lab sessions, students got the chance to practice lab tasks with the help of demonstrators. These tasks allowed students to get acquainted with the newest software tools and cloud technologies, such as GCP **(Apply)**.

Demonstrators assisted students in identifying and correcting mistakes as they practised activities, making the labs highly participatory. It is common practice for lab demonstrators to pre-upload the video of each lab demonstration **(Analyse)** for the purpose of enhancing involvement and interaction. This is especially helpful to learners enrolled in part-time classes who have other obligations. The topics presented in the class session are put into practice in the laboratory to assist simple comprehension and the development of connections. Additionally, three separate activities are taking place simultaneously: 1) the first is for students who are currently completing the lab activity; 2) the second is for learners who are finishing the previous week exercise; and 3) the third is for learners who have questions or are working on group projects. We developed five individual lab quizzes to test students' knowledge using various lab activities **(Evaluate)**. Students must dedicate two hours per week for 10 weeks to master the material that will be tested on a lab quiz. Additionally, in order to retain and comprehend important ideas, students should engage in weekly self-study. Reading assignments before and after class, as well as lab quizzes and self-study, all help students become more self-reliant learners. Participation in group projects helps students reach the second and third levels of the taxonomy.

During weeks 2, 4, 9, and 12, there were five two-hour drop-in sessions to enhance peer learning (Raza et al., 2020). At the first drop-in session (week 2), students had the opportunity to ask any questions. At the week 4 drop-in session, we provided students with an overview of the coursework and instructions for selecting group members. In addition, at the drop-in session in week 9, participants shared their project thoughts and asked any questions they had about the mini-project. A few students didn't come from a computer science background, so their advisors suggested they form groups to learn from others with more expertise in the field while also developing their technical and collaborative abilities (Luse & Rursch, 2021). Students also used a think-pair-share exercise, a great tool for group projects, to evaluate the completed mini-projects (Gerstenhaber, & Har-El, 2021). For the collaborative mini-project, learners choose the topic, area, and programming language **(Evaluate)**.

In week 12, a drop-in session was planned to assist students with general questions about the test or to review specific themes, including a discussion on model exams and misconduct-related issues. Lab tests, summative and formative evaluations, and web-based tools all contributed to students receiving continual feedback on their mini-projects. All groups were required to devote two hours per week to coursework and drop-in sessions to finish all their assigned responsibilities. For this assignment, the group had to come up with a new concept for a cloud computing project by combining their brainstorming sessions with what they knew about previous projects (Hoegl & Gemuenden, 2007). In addition, the team had to show off the product in a live or recorded demo **(Create)**. Using this organised approach, students reached the most advanced level of Bloom's taxonomy in understanding and applying cloud computing through several activities throughout the programme (Hoegl & Gemuenden, 2001). The module's ILOs were met by using Bloom's Taxonomy in a planned way for the scheduled learning materials, interactive technologies, and tasks (Mentimeter quiz, case study, interactive H5P-based video, and think-pair-share activity). As a whole, students will be able to gain advanced technical skills and work together more effectively through several levels of Bloom's taxonomy (Lage et al., 2000). Redesigning this module shows how important getting ILOs right is for supporting students' futures (Walton et al., 2017). The redesigned curriculum prioritises “employment prospects”, “group project-based teamwork”, “coping with multiculturalism”, and “student's involvement and engagement”, among other vital criteria, to promote an equitable society and facilitate multicultural growth.

Module Assessment and Feedback

Table 1 describes the most important changes made to the cloud computing module's assessments, feedback, and teaching methods as a result of the redesign. In the earlier version of this module, there were just two final exams—a written assessment and a one-on-one lab viva—and the standard method of collecting feedback from students using QMPLUS at the end of each semester. With the goal of educating over 100 students in a way that promotes social justice, student involvement, and employability, reforming the curriculum has necessitated the employment of a wide range of active learning methodologies. Three separate summative assessments were developed: a written exam, a lab quiz, and a collaborative or teamwork project. Furthermore, students were offered three opportunities to give us feedback: a Google Form survey after every class, mid-module and final VLE feedback, and two Mentimeter quizzes given out during class as extra formative assessments. All users will have equal opportunity to participate in and benefit from the many assessments, feedback, and evaluation procedures.

Table 1: Key Changes for Curriculum Redesign

Criteria	Earlier	Redesign
Assessment	**Summative Assessment** a) Final Exam b) Individual Lab Viva	**1. Summative** a) Final Exam b) 5 Lab Quizzes c) Group based Coursework **2. Formative (in each session)** a) First Mentimeter Quiz (Prior Knowledge) b) Second Mentimeter Quiz (Feedback after every session) c) Weekly review questions
Feedback	Only QMPlus Feedback	a) Google Form Survey (can do anytime in the week) 2. Six Weeks QMPlus Feedback using Traffic light model 3. Final QMPlus Feedback
Evaluation	a) Exam (85%) b) Individual Lab Viva (15%)	**1. Exam (70%)** **2. Five individual lab quiz (3% each) = 15%** **3. Group Project (15%)**

Figure 4 shows the schedule for several activities, including assessment and feedback, for this module's redesign, including formative and summative assessments and feedback.

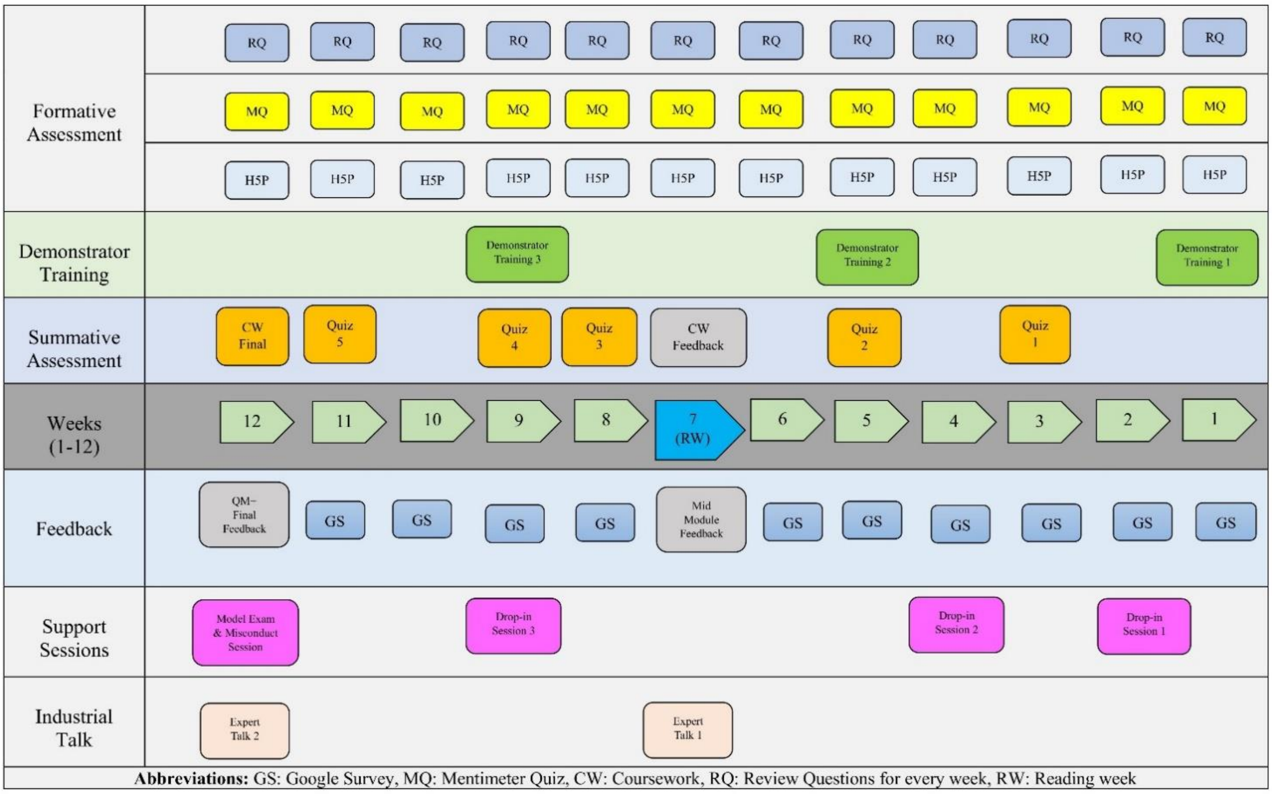

Figure 4: Timeline for Various Activities including Assessment and Feedback

WIDER CONTEXTS FOR THE MODULE

Using the most up-to-date research as a foundation, this subject teaches you the fundamentals of cloud computing and how to use the GCP cloud. To ensure that students are being tested using the most up-to-date methods and technologies, lab activities are regularly revised to align with the requirements set by tech businesses (Gill et al., 2022a). Cloud professionals make up the module group (lessons and demonstrations), which is great for learners because it incorporates research-informed learning. Learners can work on a joint project and hone their collaboration, problem-solving skills, presentation, and interaction abilities—all of which are important for improving job prospects, equality, and cross-cultural communication—thanks to the inclusion of the collaboration activity (Hoegl & Gemuenden, 2001). Learners will enhance their research abilities and be more prepared for careers in game design, software engineering, systems analysis, and application development thanks to this module's utilisation of cutting-edge tools and methodologies in laboratory exercises (Gill et al., 2024b). Drawing on the multitasking concepts covered in operating systems and programming with Python, cloud computing is a course for master's degree courses such as computer science and big data science. Cloud computing's ILOs and goals are consistent with those of these initiatives. In addition to facilitating professional opportunities, this module urges all students to enrol in applicable Massive Open Online Courses (MOOCs), submit internship or doctoral applications, and finish their degree programmes.

EVALUATION AND QUALITY ASSURANCE

Encouraging equity for diverse curricula, the module's methodical evaluation aids in assessing the performance of educational design as well as the attainment of ILOs. First, when the course was being delivered; second, after the course was finished; and third, input from graduate students according to their professional progress was used to assess the programme.

We utilised three assessment approaches during the initial phase: a Google questionnaire, mid-module feedback, and a Mentimeter quiz-based formative assessment. Every class began with a Mentimeter quiz to gauge students' prior knowledge and ended with a second exam to gauge their grasp of the day's content. Gill et al. (2022) found that using Mentimeter in virtual lectures increased student-lecturer engagement. Additionally, students may rapidly assess their advancement in achieving ILOs by taking these quizzes (Singhal et al., 2021).

In addition, students were prompted to anonymously rate the weekly material using Google questionnaires. The Traffic Light Model (Quesel et al., 2020) was utilised in this input tool to consider student recommendations and improve teaching practice and approach. In order to improve student involvement, reflective action must be implemented at this time (Nicol & Macfarlane-Dick, 2020). If certain students are unable to grasp a certain topic, for instance, the instructor can address this throughout the course by providing more instances or scenarios. As a last step, we surveyed students midway through the programme to gauge their overall happiness and how well it was able to impart social justice values (Naeem et al., 2022). Students' progress towards earning ILOs was reviewed with this input. Students not achieving enough headway were helped during labs and drop-in meetings on coursework (Gill et al., 2022).

During the second term, the student's general views on the module were evaluated through official survey responses. In addition, we looked at things like attendance and test scores (both individual assessments and overall). To monitor the participants' development throughout the module, we also looked at their gender, age, and international status (Nicaise, 2006). The students' participation and final grades further aided in determining the relationship between various feedback criteria. These metrics may be examined later on to find the places that need modification, if necessary. It is challenging to take feedback into account when trying to improve teaching practice due to the presence of various prejudices (e.g., gender difference and gender-based confidence) (Nicaise, 2006). However, case-by-case reviews of comments can help uncover potential flaws.

The third phase will review alumni students' career status reports to determine the module's efficacy in enhancing their job readiness (Naeem et al., 2022). For instance, if a learner is using obsolete tool or technology for their lab activities or coursework, this might be upgraded to increase prospective student employability; this input will be gathered via alumni relationships and used to identify the major shortcomings for stakeholders. In order to guarantee the construction of a comprehensive curriculum, we will additionally take into account the comments from colleagues and peers in order to adapt the course better based on their excellent experiences.

IMPACT OF INCLUSIVE CURRICULUM DESIGN AND RESULT OUTCOMES

We have used the result outcomes from the cloud computing module, which is offered as part of the Master of Science (MSc) in Computer Science and Big Data programmes within the School of Electronic Engineering and Computer Science at QMUL. In this case study, we have considered three different phases: pre-covid (2018–19), during-covid (2019–20), and post-covid (2020–23) for different result outcomes. The impact of inclusive curriculum design on a variety of metrics, including pass rate, student feedback, employability, industry involvement, collaboration, and student participation and engagement, is discussed in this section, along with the formative evaluations of the results.

Student Engagement and Attendance

We have considered only the academic year 2022-2023 to analyse student engagement and attendance. During each session, students were given a Mentimeter quiz with five multiple-choice or true/false questions to use as formative assessments. Examining students' knowledge and comprehension of earlier material was the primary goal of the tests. In the academic year 2022-2023 at QMUL, 77 students were enrolled in the cloud computing course. Figure 5 depicts the administration of the weekly online quizzes (Multiple Choice Questions (MCQs) and True or False (T/F)) during online sessions as a formative assessment. This also indicates that 66 out of 77 students have taken the Mentimeter assessment during the first week of class, indicating that students are more engaged when they use web-based tools to supplement their online education. However, participation declined over the course of a few weeks, which may suggest that students were preoccupied with other course requirements.

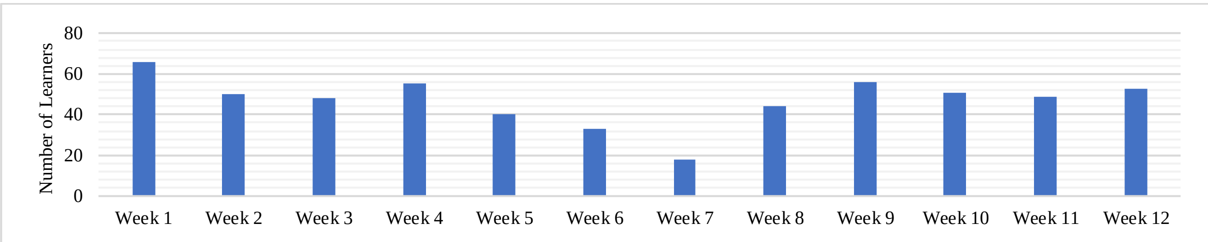

Figure 5: Mentimeter Based quizzes during the session

Figure 6 indicates the relationship between videos based on H5P that students are required to watch before each session to grasp the fundamentals of the topics that will be addressed. After watching H5P-based videos, students can evaluate their understanding of the topic by taking an online quiz using Mentimeter. Since implementing these changes, there has also been an increase in the number of students who are present in both the lectures and labs, which is another positive impact of the curriculum redesign.

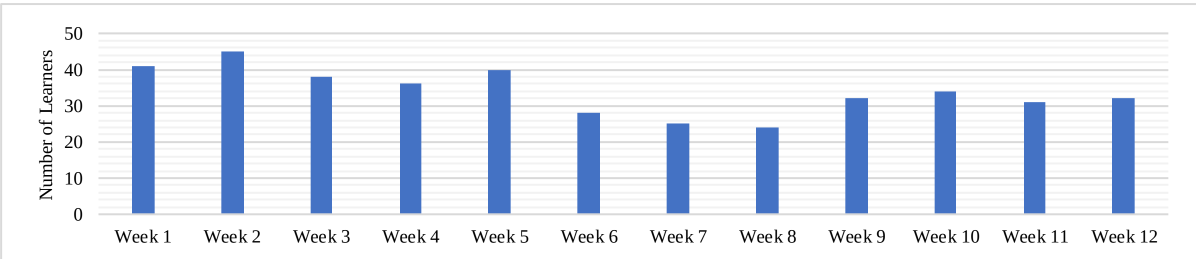

Figure 6: Pre-session engagement with H5P-based videos

Pass Rate

To analyse the pass rate, we have considered two different phases: during-covid (2019–20) and post-covid (2020–23). Figure 7 shows the impact of the module redesign on the pass rate of the students, which has increased from 86% in 2019–20 to 96% in 2022–23. In 2021–22, we had the largest group of students, and the pass rate was 92%, higher than in during-covid (2019–20). This shows that the new teaching activities in the module redesign positively impact the student pass rate.

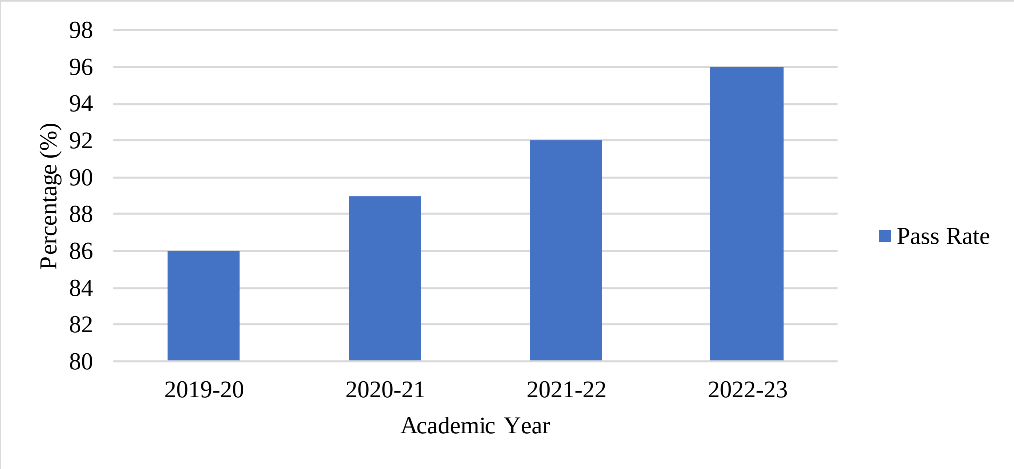

Figure 7: Impact of Inclusive Curriculum Design on Pass Rate

Student Satisfaction Rate

To analyse the student satisfaction rate, we have considered three different phases: pre-covid (2018–19), during-covid (2019–20), and post-covid (2020–23). Figure 8 shows the impact of the redesign of the cloud computing module on the student satisfaction rate collected through the central QMUL module evaluation system. It shows that the feedback has improved from a mean score of 3.15 out of 5 in 2019–20 to 4.71 in 2022–23, where 68 out of 77 students have provided feedback. The conclusion that can be drawn from this trend is that the changes to the module design have both impacted the quality of student's experiences and the likelihood of them submitting feedback, indicating enhanced engagement.

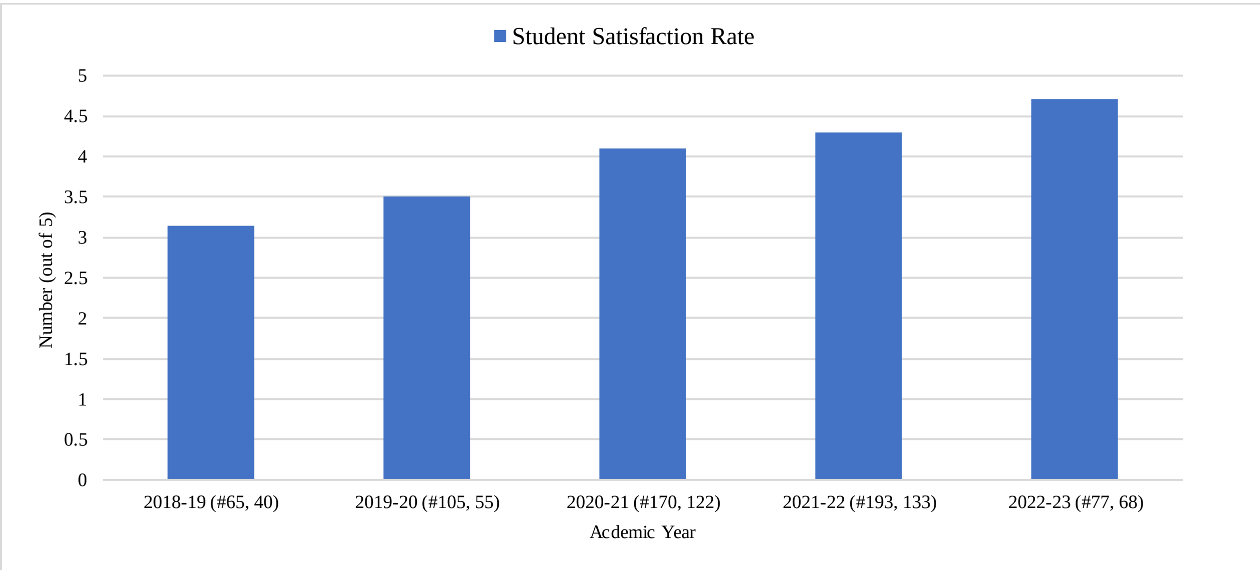

Figure 8: Impact of Inclusive Curriculum Design on Student Satisfaction Rate

Coursework Completion Rate

To analyse the coursework completion rate, we have considered three different phases: pre-covid (2018–19), during-covid (2019–20), and post-covid (2020–23). Figure 9 shows the impact of the redesign of the module on the coursework completion rate. The cloud computing module was delivered in different modes in the last five years, including post-covid time such as online mode (2020–21), mixed or hybrid mode (2021–22), and in-person (2022–23). We have achieved a 100% coursework completion rate in 2022–23, which clearly shows that support sessions in the form of drop-ins and other module format changes have a positive impact on the coursework completion rate.

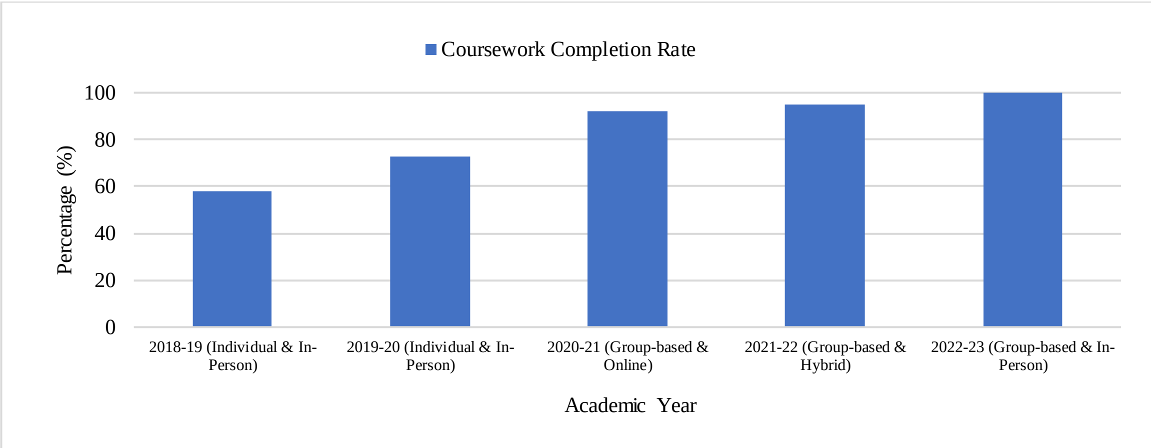

Figure 9: Impact of Inclusive Curriculum Design on Coursework Completion Rate

Employability Rate

To analyse the employability rate, we have considered three different phases: pre-covid (2018–19), during-covid (2019–20), and post-covid (2020–23). Figure 10 shows the impact of the redesign of the cloud computing module on the employability rate, where 52% of students got jobs in cloud-based companies in 2022–23. We believe this indicates that the changes made based on research conducted with alumni and employers, such as using the latest technologies and industry trends and incorporating teamwork skills, positively impact the employability rate.

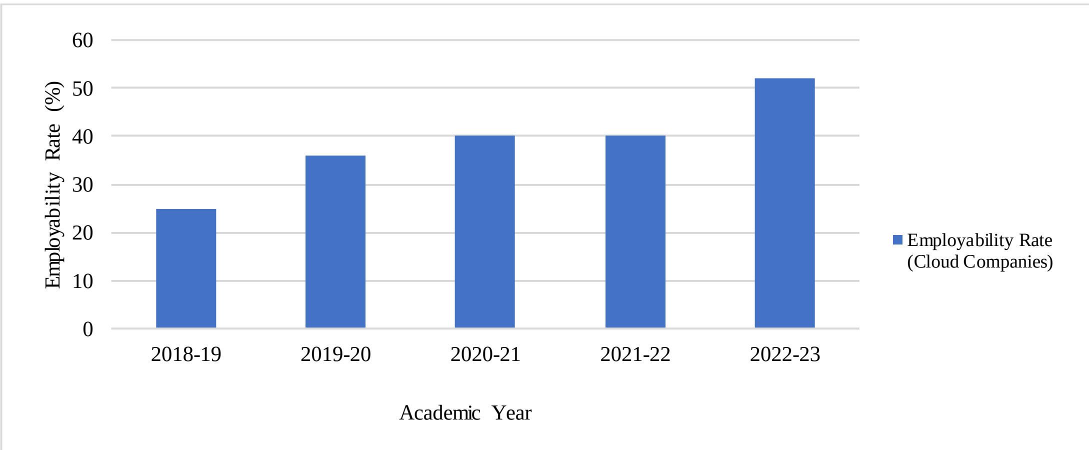

Figure 10: Impact of Inclusive Curriculum Design on Employability Rate

To support the changes to the curriculum, we have collected feedback and recommendations from the alumni of the cloud computing module who are working in cloud-based companies, such as that it is beneficial to use the latest technologies and industry trends in the labs to learn practical skills, and incorporating group projects will help to learn teamwork skills by providing students with diversity and different educational backgrounds, which helps create an inclusive curriculum for employability. We considered the alumni now doing internships, jobs, and pursuing PhDs or completing online certificates. We have used the following questionnaire to collect feedback:

a) In your opinion, does the cloud computing module you have access to contain useful concepts that you can use to advance your career? Please rate this on a scale from 1 to 5.
b) Are you certified in the latest cloud computing platforms and technological advances? If so, have you passed the related online exams?
c) Are you prepared to succeed in your future career by acquiring the abilities studied in cloud computing that are necessary for the job?
d) Are you in the process of deciding whether to accept the post, the job, or a PhD study opportunity?

Research Publications

To analyse the research publications, we have considered two different phases: during-covid (2019–20) and post-covid (2020–23). Figure 11 shows the impact of the cloud computing module redesign on the research publications produced by MSc students who studied cloud computing modules, completed MSc projects, and continued MSc dissertations by extending their cloud computing projects under the supervision of the lecturer of the cloud computing module. These MSc publications were published in prominent journals such as IEEE Journal of Biomedical and Health Informatics (Q1 Journal with impact factor = 7.7), IEEE Internet of Things (IoT) Journal (Q1 Journal with impact factor = 10), Elsevier IoT Journal (Q1 with Impact Factor = 6), IEEE Consumer Electronics Magazine (Q1 with Impact Factor = 4.5), Wiley Internet Technology Letters (Impact Factor = 1.5), Springer Wireless Personal Communications (Impact Factor = 2.2), book chapters in Springer, Elsevier, and CRC Press. MSc publication has increased from 3 in 2019–20 to 7 in 2022–23, where an academic can supervise a maximum of 8 MSc students. Further, a research book published in CRC Press contains 18 MSc dissertations from the Networks research group at QMUL.

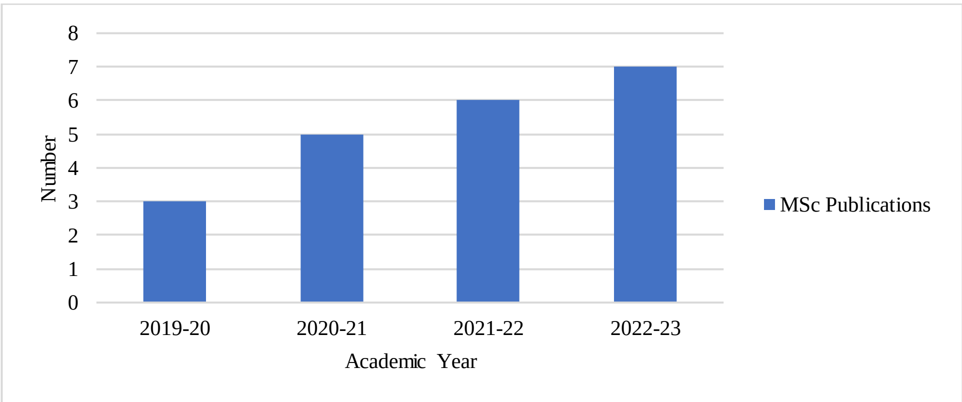

Figure 11: Impact of Inclusive Curriculum Design on Number of MSc publications

Professional Cloud Certifications

To analyse the successful achievement of professional cloud certifications, we have considered two phases: during-covid (2019–20) and post-covid (2020–23). Figure 12 shows the impact of redesigning the cloud computing module on the professional cloud certifications students receive after completing the cloud computing module at QMUL. In 2019–20, we motivated students to apply for professional cloud certifications, which would be helpful to get jobs in cloud-based companies. 10 students have successfully attained professional cloud certifications in the academic year 2019–20. In the last four years, the number of students who have completed professional cloud certifications has increased, and 28 students have completed professional cloud certifications in the academic year 2022–23.

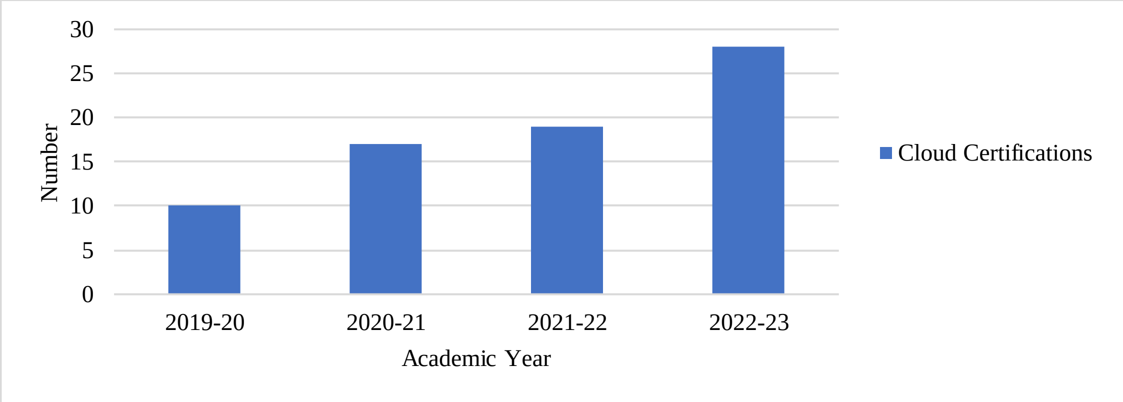

Figure 12: Impact of Inclusive Curriculum Design on Cloud Certifications

Industry Engagement

To analyse the industry engagement within the cloud computing module, we have considered only the post-COVID (2020–24) phase. Figure 13 shows the number of invited and delivered industrial talks in the last four years, which are vital for students to build their connections with industry and to understand the expectations and skills level required of candidates for tech industries in the UK.

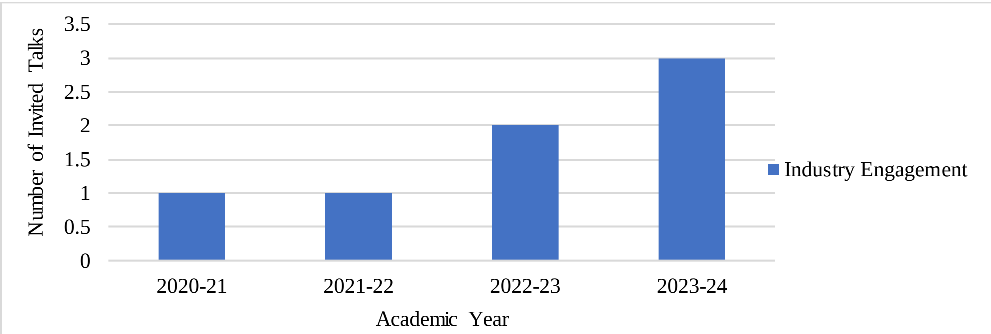

Figure 13: Industry Engagement in Cloud Computing Module.

CONCLUSIONS AND RECOMMENDATIONS

The cloud computing module at QMUL has been redesigned as part of this research project with the intention of enhancing student learning, engagement, and employment for excellence in higher education. Additionally, it was updated to be more inclusive to support the learning of a larger and more diverse cohort of students. As part of the redesign, one of the objectives was to render higher education more welcoming to students of all backgrounds and to encourage conversation between people of different cultures. By incorporating active learning activities like interactive videos, Mentimeter quizzes, collaborative projects, and lab quizzes, we were able to promote activation and the sharing of prior knowledge. This course offered a wonderful opportunity to evaluate inclusive teaching approaches. Through the feedback sought on the module, we were able to implement a number of initiatives to enhance inclusivity. We have a comprehensive understanding of cloud computing, particularly about the implementation of cutting-edge and well-established research trends in the sector (Gill et al., 2024b). Since there is a strong relationship between research and education, which motivates participants to engage in cloud research (Feldon et al., 2011), conducting research on the same subject is essential. Furthermore, this will give students an excellent opportunity to locate a mini-project topic pertinent to their final year MSc project. In addition, it helps participants increase their intellectual capacity by allowing them to finish their mini-projects on difficult concepts. Learners will gain from this teaching approach since they will gain knowledge and skills for cloud computing, research knowledge and skills, as well as employability skills such as teamwork and communication. Students who may not already possess social capital, relationships, or networks can advance their professional growth using this instructional approach.

Positive Aspects

A significant number of modifications were made to the material over the previous years (the educating cloud computing course in the years 2018–19), but the subject matter has developed significantly since then. On the whole, the materials that were provided, as well as the lectures that were presented, were enhanced. In order to give students the opportunity to get real-world experience, lab activities and coursework are now based on a genuine cloud platform known as Google Cloud Platform (GCP). For the purpose of ensuring that every student learned skills in collaboration while collaborating within a group, the collaborative project element was implemented (Gill et al., 2022). Everyone in the class has turned in their assignments on time, and the majority of the students have already tried their lab quizzes before the due date. There are a good number of students who have responded to the review questions on a weekly basis, which makes this module more interactive and inclusive.

Implications of this Study

Through this analysis of curriculum redesign, we gained a greater understanding of our role as researchers and educators, as well as how to support students in their professional capabilities through teamwork-based projects. Our investigation strategy for the cloud computing module at QMUL has been well-received online and in person. Hopefully, it will be used as a model for future efforts to foster collaboration at the collegiate and institutional levels. Additional schools at QMUL, as well as other institutes, can use this research as a model for creating long-term, resilient learning environments for computer science and other educational modules. In addition, we created focus groups to investigate the pros and cons of a new team-based group project and found that students learned a lot and improved their technical and interpersonal abilities by working together. Students in Computer Science and Engineering at QMUL have benefited from this research plan's execution in three ways: their views on involvement, the current state of computer science learning, and suggestions for future efforts to increase student participation. Learners have been urged to share their thoughts during the entire procedure via various feedback and informal assessments, thanks to the effective execution of the action study strategy. Future researchers and educators might learn from this successful study approach by implementing it into their own classroom instruction in computer science and related subjects.

Recommendations

We have identified the following recommendations for future academics based on our findings:

1) **Demonstrator Training:** The technical expertise of the demonstrators is very important so that they can help students actively, which would be useful for them to achieve the level expected for demonstrations. There is a need for senior demonstrators to train new demonstrators in week 0 (or provide training after every 2 weeks), which effectively manages the process. Further, regular meetings with the new demonstrators should be held to check how things are going and provide training or help if they need it.
2) **Subtitles:** Further, lecturers should use subtitles during presentations in the class to make it easier for those who have difficulty understanding accents (Gill et al., 2024a). This will help students understand the lecture content easily.
3) **Continuous Feedback:** It has also been identified that consultation with alumni and employers to support the development of an inclusive curriculum for employability is very important and useful.

REFERENCES

Achuthan, K., & Murali, S. S. (2017). *Virtual lab: an adequate multi-modality learning channel for enhancing students' perception in chemistry*. In Computer Science On-line Conference Springer, Cham, 419-433.

Achuthan, K., Francis, S. P., & Diwakar, S. (2017). Augmented reflective learning and knowledge retention perceived among students in classrooms involving virtual laboratories. *Education and Information Technologies*, 22(6), 2825-2855.

Adam, A., Skalicky, J., & Brown, N. (2011). Planning sustainable peer learning programs: An application and reflection. *Student Success*, 2(2), 9.

Cavinato, A. G., Hunter, R. A., Ott, L. S., & Robinson, J. K. (2021). Promoting student interaction, engagement, and success in an online environment. *Analytical and Bioanalytical Chemistry*, 413, 1513–1520.

Clifford, V., & Montgomery, C. (2017). Designing an internationationalised curriculum for higher education: Embracing the local and the global citizen. *Higher Education Research & Development*, 36(6), 1138-1151.

Ford, D. Y., & Scott, M. F. T. (2021). Culturally responsive and relevant curriculum: The revised Bloom-Banks Matrix. In Introduction to curriculum design in gifted education (pp. 331-349). Routledge.

Feldon, D. F., Peugh, J., Timmerman, B. E., Maher, M. A., Hurst, M., Strickland, D., ... & Stiegelmeyer, C. (2011). Graduate students' teaching experiences improve their methodological research skills. *Science,* 333(6045), 1037-1039.

Geiger, O. G., & Bostow, D. E. (1976). Contingency-managed college instruction: Effects of weekly quizzes on performance on examination. *Psychological Reports*, 39(3), 707-710.

Gerstenhaber, J. A., & Har-El, Y. E. (2021). Virtual biomaterials lab during COVID-19 pandemic. *Biomedical engineering education*, 1(2), 353-358.

Gill, S. S., Naeem, U., Fuller, S. Chen, Y., & Uhlig, S. (2022). How Covid-19 Changed Computer Science Education, *ITNOW*, 64 (2), Issue 2, 60–61.

Gill, S. S., Thibodeau, D., Kaur, R., Naeem, U., & Stockman, T. (2023a). Reflection on Teaching Observation for Computer Science and Engineering to Design Effective Teaching Resources in Transnational Higher Education. *In Handbook of Research on Developments and Future Trends in Transnational Higher Education* (pp. 307-325). IGI Global.

Gill, S. S., Cabral, A., Fuller, S., Chen, Y., & Uhlig, S. (2023b). Facilitating an Online and Sustainable Learning Environment for Cloud Computing Using an Action Research Methodology. *In Handbook of Research on Implications of Sustainable Development in Higher Education* (pp. 43-70). IGI Global.

Gill, S. S., Fuller, S., Cabral, A., Chen, Y., & Uhlig, S. (2023c). An Operating System Session Plan Towards Social Justice and Intercultural Development in Microteaching for Higher Education. *In Handbook of Research on Fostering Social Justice Through Intercultural and Multilingual Communication* (pp. 44-61). IGI Global.

Gill, S. S., Fuller, S., Cabral, A., Chen, Y., & Uhlig, S. (2023d). Curriculum Redesign for Cloud Computing to Enhance Social Justice and Intercultural Development in Higher Education. *In*

Handbook of Research on Fostering Social Justice Through Intercultural and Multilingual Communication (pp. 62-80). IGI Global.

Gill, S. S., Xu, M., Patros, P., Wu, H., Kaur, R., Kaur, K., ... & Buyya, R. (2024a). Transformative effects of ChatGPT on modern education: Emerging Era of AI Chatbots. *Internet of Things and Cyber-Physical Systems*, 4, 19-23.

Gill, S.S., Wu, H., Patros, P., Ottaviani, C., Arora, P., Pujol, V.C., Haunschild, D., Parlikad, A.K., Cetinkaya, O., Lutfiyya, H. and Stankovski, V., (2024b). Modern computing: vision and challenges. *Telematics and Informatics Reports*, 13, p.100116.

Gunawan, G., Harjono, A., Sahidu, H., & Herayanti, L. (2017). Virtual laboratory to improve students' problem-solving skills on electricity concept. *Journal Pendidikan IPA Indonesia*, 6(2), 257-264.

Hager, P., Sleet, R., & Kaye, M. (1994). The relation between critical thinking abilities and student study strategies. *Higher Education Research and Development*, 13(2), 179-188.

Hanna, W. (2007). The new Bloom's taxonomy: Implications for music education. *Arts Education Policy Review*, 108(4), 7-16.

Hoegl, M., & Gemuenden, H. G. (2001). Teamwork quality and the success of innovative projects: A theoretical concept and empirical evidence. *Organization science*, 12(4), 435-449.

Hoegl, M., & Parboteeah, K. P. (2007). Creativity in innovative projects: How teamwork matters. *Journal of Engineering and Technology Management*, 24(1-2), 148-166.

Hughes, M., Salamonson, Y., & Metcalfe, L. (2020). Student engagement using multiple-attempt 'Weekly Participation Task'quizzes with undergraduate nursing students. *Nurse Education in Practice*, 46, 22-36.

Kapilan, N., Vidhya, P., & Gao, X. Z. (2021). Virtual laboratory: A boon to the mechanical engineering education during covid-19 pandemic. *Higher Education for the Future*, 8(1), 31-46.

Kooijman, L., Asadi, H., Mohamed, S., & Nahavandi, S. (2022). Does the Vividness of Imagination Influence Illusory Self-Motion in Virtual Reality?. *In 2022 IEEE International Conference on Systems, Man, and Cybernetics (SMC),* 1065-1071.

Lage, M. J., Platt, G. J., & Treglia, M. (2000). Inverting the classroom: A gateway to creating an inclusive learning environment. *The journal of economic education*, 31(1), 30-43.

Luse, A., & Rursch, J. (2021). Using a virtual lab network testbed to facilitate real-world hands-on learning in a networking course. *British Journal of Educational Technology*, 52(3), 1244-1261.

Masapanta-Carrión, S., & Velázquez-Iturbide, J. Á. (2018). A systematic review of the use of bloom's taxonomy in computer science education. *In Proceedings of the 49th ACM technical symposium on computer science education*, 441-446.

Mayhew, E. (2019). No longer a silent partner: How Mentimeter can enhance teaching and learning within Political Science. *Journal of Political Science Education*, 15(4), 546-551.

Naeem, U., Bosman, L., & Gill, S. S. (2022, March). Teaching and Facilitating an Online Learning Environment for a Web Programming Module. *In 2022 IEEE Global Engineering Education Conference (EDUCON)* (pp. 769-774). IEEE.

Nicol, D. J., & Macfarlane-Dick, D. (2006). Formative assessment and self-regulated learning: A model and seven principles of good feedback practice. *Studies in higher education*, 31(2), 199-218.

Nicaise, V., Cogérino, G., Bois, J., & Amorose, A. J. (2006). Students' perceptions of teacher feedback and physical competence in physical education classes: Gender effects. *Journal of teaching in Physical Education*, 25(1), 36-57.

O'Brien, K., King, H., Phillips, J., Dalton, Kath, and Phoenix. (2022). "Education as the practice of freedom?"–prison education and the pandemic. *Educational Review*, 74(3), 685-703.

Pappas, E., Pierrakos, O., & Nagel, R. (2013). Using Bloom's Taxonomy to teach sustainability in multiple contexts. *Journal of Cleaner Production*, 48, 54-64.

Parson, L., & Ozaki, C. C. (Eds.). (2020). *Teaching and Learning for Social Justice and Equity in Higher Education: Foundations*. Springer Nature.

Quaye, S. J., Harper, S. R., & Pendakur, S. L. (Eds.). (2019). Student engagement in higher education: Theoretical perspectives and practical approaches for diverse populations. Routledge.

Quesel, C., Schweinberger, K., & Möser, G. (2020). Responses to positive and negative feedback on organizational aspects of school quality: teachers' and leaders' views on a Swiss traffic light approach to school inspection. *School Effectiveness and School Improvement*, 1-18.

Raza, S. A., Qazi, W., & Umer, B. (2020). Examining the impact of case-based learning on student engagement, learning motivation and learning performance among university students. *Journal of Applied Research in Higher Education*, 12(3), 517-533.

Ryan, A., & Tilbury, D. (2018). Uncharted waters: voyages for education for sustainable development in the higher education curriculum. *In Education for Sustainable Development (pp. 104-126)*. Routledge.

Salmon, N., García Iriarte, E., & Burns, E. Q. (2017). Research Active Programme: A pilot inclusive research curriculum in higher education. *International Journal of Research & Method in Education*, 40(2), 181-200.

Serrano, D. R., Dea-Ayuela, M. A., Gonzalez-Burgos, E., Serrano-Gil, A., & Lalatsa, A. (2019). Technology-enhanced learning in higher education: How to enhance student engagement through blended learning. *European Journal of Education*, 54(2), 273-286.

Singhal, R., Kumar, A., Singh, H., Fuller, S., & Gill, S. S. (2021). Digital device-based active learning approach using virtual community classroom during the COVID-19 pandemic. *Computer Applications in Engineering Education*, 29(5), 1007-1033.

Smith, S., Pickford, R., Sellers, R., & Priestley, J. (2021). Developing the Inclusive Course Design Tool: a tool to support staff reflection on their inclusive practice. *Compass: Journal of Learning and Teaching*.

Sosniak, L. A. (1994). *Bloom's taxonomy*. L. W. Anderson (Ed.). Chicago, IL: Univ. Chicago Press.

Stanny, C. J. (2016). Reevaluating Bloom's Taxonomy: What measurable verbs can and cannot say about student learning. *Education Sciences*, 6(4), 37.

Suzuki, S. N., Akimoto, Y., Kobayashi, Y., Ishihara, M., Kameyama, R., & Yamaguchi, M. (2018). A proposal of method to make active learning from class to self-study using active note taking and active textbook system. *Procedia Computer Science*, 126, 957-966.

Testa, D., & Egan, R. (2014). Finding voice: The higher education experiences of students from diverse backgrounds. *Teaching in Higher Education*, 19(3), 229-241.

Walton, R., Colton, J. S., Wheatley-Boxx, R. K., & Gurko, K. (2017). Social justice across the curriculum: Research-based course design. *Programmatic Perspectives*, 8(2), 119.

Yousef, A. M. F., Chatti, M. A. and Schroeder, U. (2014), Video-Based Learning: A Critical Analysis of The Research Published in 2003–2013 and Future Visions, *In Proceeding of the Sixth International Conference on Mobile, Hybrid, and Online Learning*, Barcelona, Spain, 112–119.

Yusuf, I., & Widyaningsih, S. W. (2020). Implementing E-Learning-Based Virtual Laboratory Media to Students' Metacognitive Skills. *International Journal of Emerging Technologies in Learning*, 15(5), 1-12

KEY TERMS AND DEFINITIONS

Learner: Both "student" and "participant" are synonyms for this term, which is used alternately.

Cloud Computing: The pay-as-you-go model On-demand access to information technology resources is provided over the web.

Curriculum Redesign: An outstanding study of the talents that contemporary students need to possess in order to be successful in both the society of nowadays and the community of tomorrow.

Think-pair-share: Students collaborate to find the solution to a problem or fix a problem related to a text they have been given.

Formative Assessment: The goal of formative assessment is to keep tabs on student progress and provide comments that teachers may use to improve their own teaching and how students learn.

QMPLUS: This is the online learning environment (OLE) that everyone at Queen Mary University of London uses, which is designed on Moodle.

ADDITIONAL READING

Chandrasekaran, K. (2014). *Essentials of cloud computing*. CrC Press.

Goteng, G. L., Shohel, M. M. C., & Tariq, F. (2022). Enhancing student employability in collaboration with the industry: Case study of a Partnership with Amazon web Services Academy. *Education Sciences*, 12(6), 366.

Field, J., Martin, N., Duane, B., Vital, S., Mulligan, S., Livny, A., ... & Dixon, J. (2023). Embedding environmental sustainability within oral health professional curricula—Recommendations for teaching and assessment of learning outcomes. *European Journal of Dental Education*, 27(3), 650-661.