

## Assessment and Recognition of MOOCs: The State of the Art

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### Abstract

**This study presents a descriptive overview of assessment and verification** techniques used and emergent in contemporary online learning platforms. The Covid-19 pandemic has encouraged many institutions to move to online examinations at scale. Verification of learner identity is thus increasingly important for online education in examination and proctoring. Here we review state of the art approaches to ID verification, recognition, and assessment in Massive Open Online Courses (MOOC). Desktop research included research publications, grey literature, and direct interactions with MOOC platforms to identify current practices. The main focus was on public data from course pages on MOOC platforms, and particularly courses that had been grouped to offer a single academic program. Four approaches to verification of identity are described: basic identity checks; checks made by the university; external proctoring; and various types of interview. Our review demonstrates the absence of any universal approach. However, the emergent picture indicates increasing co-ordination across relevant stakeholders (including higher education institutions, employment services and the private sector). There remain significant challenges for online proctoring, including overcoming learner preferences and meeting the increased resourcing needed for human-led processes of identity verification. There remain significant ethical challenges regarding the use of learner data (especially biometrics). As a result, MOOC platforms may benefit from adopting identity verification strategies that are well-established in higher education institutions, such as plagiarism checking software and pedagogies like e-portfolios..

**Keywords:** assessment, exams, ID verification, MOOC platforms, MOOCs, proctoring, recognition, micro-credentials

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## INTRODUCTION

**The rise of Massive Open Online Courses (MOOCs) has been** a significant factor in the increase in online education over the last decade. MOOCs began as a Canadian experiment in teaching and learning (Cormier, 2008) and were scaled up through platformization over the last decade. There are now many thousands of MOOCs available at differing levels of complexity. MOOCs are often openly available in the sense that they can be accessed free of charge by unlimited numbers of learners (Ferguson, 2019) even if the course content itself is not openly licensed.

During 2020, this trend was significantly accelerated by Covid-19 (Bozkurt et al., 2020). ClassCentral (2020) reports that MOOC providers launched more than 2800 courses, 360 micro-credentials, and 19 online degrees during 2020. Similarly, one third of all MOOC learners ever to register for a course did so in 2020—approximately 60 million new learners from around 180 million who have taken a MOOC with a major platform (ClassCentral, 2020).

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Although more than 60 MOOC based degrees are available (ClassCentral, 2020) the majority of MOOCs are not formally accredited. Learners have access to content, and often some access to educators, but rarely to academic or professional credit. There are two important blockers here. First, verification of identity (ID) is challenging—and costly—when learners are distributed across the world. Second, the processes of marking and quality assuring assessment are demanding—and costly—when any one course presentation may have tens of thousands of learners. Low-cost substitutes includes digital badges and Statements of Attainment, Completion or Participation (de Barba et al., 2016; Jansen et al., 2017).

For some learners, this state of affairs presents no problem; they have gained the skills and knowledge they need; their learning needs are met (Milligan & Littlejohn, 2017). For others – particularly those who have been unable to access traditional forms of Higher Education – this can present a significant gap in provision. Employers looking for evidence of professional training can also find such arrangements unsatisfactory as qualifications developed through online learning at scale may be perceived as lower quality or less rigorous in assessment.

There is thus a growing awareness of the need to rethink and reassess how learning is validated and recognized through collaboration between educational institutions, employers and labour markets. As MOOC platforms have shifted their business models towards revenue-producing courses which include micro-credentials and/or “nano” degrees (Lemoine & Richardson, 2015; Oliver, 2019; Rossiter & Tynan, 2019) there is an increasing need for accurate and authentic forms of assessment and identity verification which work at a distance.

## **THE EUROPEAN MOOC CONSORTIUM: LABOUR MARKETS KNOWLEDGE ALLIANCE**

In this paper, we aim to describe the state of the art with respect to assessment and recognition in MOOCs. Our endeavor is grounded in the attempt to provide a practical knowledge base about MOOC assessment for a range of relevant stakeholders. We make no claims to statistical validity or efficacy per se in our account of the topography. Rather, we propose to capture and describe the range of implementations that presently exist and show what is considered effective practice at present.

This work is carried out as part of the European MOOC Consortium: Labour Markets (EMC-LM, n.d.) project, the first phase of which runs from 2019-2021. The EMC-LM Knowledge Alliance, funded under Erasmus+, is an outcome from the European MOOCs Consortium which comprises the major

European MOOC platforms (Futurelearn, FUN, Miriadax and EduOpen) in collaboration with trade and industry associations (ANPAL: Agenzia Nazionale Politiche Attive Lavoro [Italy]; Ocpiat [France]; VDAB [Belgium]) and higher education institutions with an interest in online education (The Open University [UK]; Università di Foggia [Italy]).

The European context is characterized by a landscape of competing and contrasting qualifications which operate across different national, disciplinary, professional and linguistic borders (EU, 2020). A lack of common formats, standards and systems of recognition results in a patchwork approach which is not very coordinated. Furthermore, the changing nature of work and training means there is great demand for a successful, strategic approach to reskilling and upskilling. Alongside the growing influence of digitalization and the impact of Covid-19 there is a pressing need to build systems of assessment and recognition that are adequate to contemporary need.

EMC-LM foresees a convergence of interests around leveraging the digitization of education; developing sustainable MOOC business models; and developing a more responsive and flexible labour market at the European level. EMC-LM has facilitated the development of a European-wide approach to micro-credentialling, which aims to realise the potential of MOOCs to support both higher education and the needs of the labour market through shared recognition of learning.

This study was conducted to support the development and implementation of the framework by researching the state-of-the-art and effective practice for MOOC platforms in the key areas of identity verification, summative assessment, and methods of recognition. The Common Micro-credential Framework (CMF) (Bowden, 2020) is aligned with the European Qualifications Framework (EQF, n.d.) and requires the use of a reliable ID verification system, and a summative assessment so that academic credit can be reliably and accurately awarded. These micro-credentials are then mutually recognized by the relevant parties (educational institutions, employers, industry bodies, trade associations, etc.) and have an agreed workload and curriculum. To meet the requirements of the CMF, micro-credentials must include total workload (or study time) of 100-150 hours, including the summative assessment (which awards academic credit and produces a transcript) (para. 4).

## **METHOD**

Both primary and secondary research was conducted. Through secondary research we systematically collected data from research publications and grey literature. This was used to

identify key criteria and points of comparison across the platforms examined in primary research. Time was spent auditing and reviewing MOOC courses and platforms to identify current standards and practices. The focus was on publicly available data from course pages on MOOC platforms: particularly courses that had been grouped to offer a single academic program, those that offered academic credit, and those that met the criteria of the CMF (FutureLearn, n.d.). Namely:

- having a total workload (or study time) of 100-150 hours, including revision for, and completion of, the summative assessment;
- being levelled at Levels 6-7 in the European Qualification Framework or the equivalent levels in the university's national qualification framework, or be levelled at Levels 4-5 and fulfil the criteria of the European Credit Transfer and Accumulation System;
- providing a summative assessment that awards academic credit, either directly following successful completion of the micro-credential or via recognition of prior learning upon enrolment as a student on a university's course of study;
- using a reliable method of ID verification at the point of assessment that complies with the recognised university's policies and/or is widely adopted across the platforms authorised to use the CMF; and
- providing a transcript that sets out the learning outcomes for a micro-credential, total study hours required, EQF level, and number of credit points earned.

As practice on MOOC platforms is a dynamic and transformative area of practice, and the move to widespread credentialing is relatively recent, examples from prior to 2019 are not included in this study. European platforms EduOpen (2018), France Université Numérique (FUN, n.d.), FutureLearn, and Miríadax (2019) were compared because these are the ones already most closely aligned with the CMF. USA-based platforms Coursera (45 million learners), edX (24 million learners) and Udacity (11.5 million learners) (Shah, 2019) were included both because of their scale and because they all offer micro-credentials or a similar qualification.

Another important part of identifying cases was to draw on the expertise across the EMC-LM consortium. All members of EMC-LM were asked to contribute examples, using a survey and online interviews to gather consistent responses in relation to platforms where the primary language is not English. This provided perspectives from universities and employment organisations, from countries across Europe, and in multiple languages. Desktop

research also took into account relevant projects funded by the European Union, including MOOQ (n.d.), TeSLA (n.d.), MoonLite (Trager, 2015), BizMOOC (2018), E-SLP (n.d.), and OpenupEd (Rosewell & Jansen, 2014).

This approach identified 66 examples of potential good practice from MOOC platforms based in Europe and the US. These cases were examined for practices in ID verification, summative assessment, and methods of recognition. In some cases (particularly on the Udacity and edX platforms), assessment and identification methods were the same on multiple courses. In these cases, a representative sample was included in the study, capturing the breadth and variety of practice across courses and platforms.

Results are reported under the categories of ID verification systems, methods of recognition, quality assurance processes, academic credits, professional recognition, combined recognition, and a review of assessment methods.

## RESULTS

### Id Verification Systems

The Common Micro-credential Framework (CMF) specifies that courses, or sets of courses, should deploy a reliable method of ID verification at the point of the summative assessment. ID verification is the process by which a learner's ID is matched with an image of that learner, enabling platforms to issue verified certificates or to award credits. In the broader context of online assessment, it is also important to verify the authenticity and authorship of assessment (Mellar, 2016). "Authenticity" connotes that the learner is the person who completed the assessment, while "authorship" means that the learner has not cheated or plagiarized to produce that work under assessment conditions. Verification processes typically require time and resources to complete so have an associated cost that must be taken into account.

A reliable ID verification method in online assessment will verify authenticity and authorship. Good practice should verify authenticity and authorship at the point of taking the assessment. Better practice is a scalable verification method that is affordable in terms of cost and time.

Four categories of ID verification method currently in use for micro-credentials hosted on MOOC platforms were identified (see Table 1). These categories, arranged in order of rigour and scalability, are: basic ID verification system, university registration, proctoring an exam, and interviews. We also note the existence of a potential fifth category, specified but not yet used in practice, the TeSLA system.

**Table 1:** Summary of identity verification systems

| Main Category                         | Sub-category                     | Brief Description  | Level of practice | Advantages  | Disadvantages  |
|---------------------------------------|----------------------------------|--|-------------------|---|--|
| <b>Basic Platform ID Verification</b> | Basic Platform ID Verification   | Learner's photo matched with ID.   | Basic             | Common across platforms – scalable  | Not at the point of assessment – minimum level of verification   |
| <b>University Registration</b>        | University Registration          | Learners complete a registration process within the university as non-degree students.                     | Basic             | Second layer of authentication – scalable                                   | Not at the point of assessment   |
| <b>Proctoring Exams</b>               | Random Proctoring                | Software takes pictures at random times during the exam; sends similarity report to institution.           | Good              | Layer of authentication at the point of assessment – scalable               | Coverage not continuous. Only deployed in exams  |
|                                       | Full Live Proctoring             | Human proctors exam using software.  | Good              | More rigour at point of assessment  | Not scalable for logistical reasons. Only deployed in exams  |
|                                       | Full Recorded Proctoring         | Exam session recorded; checked by a human. Similarity report sent to the instructor                        | Better            | More rigour at point of assessment –scalable                                | Only deployed in exams   |
| <b>Interviews</b>                     | Interview: On Site               | Interview conducted at university premises   | Basic             | Reliable in terms of authenticity and authorship                            | Not scalable due to geographical limitations   |
|                                       | Interview: Online                | Short online interview to verify student identity and work   | Good              | Reliable in terms of authenticity and authorship at the point of assessment | Increase in time and cost per verification if scaled   |
|                                       | Interview: Recorded Presentation | Presentation recorded as part of capstone project  | Better            | At the point of assessment – scalable – flexibler                           | Increase in time and cost if scaled. No real-time guidance for learner to verify authenticity and authorship of work |
| <b>TESLA System</b>                   | TESLA System                     | Verification of authenticity and authorship across various e-assessment scenarios using different software | Better            | At the point of assessment for different scenarios – scalable – flexible    | Not implemented on MOOC platforms – still in pilot stage – some privacy concerns                                     |

### **Basic Platform ID Verification Systems**

Basic Platform ID Verification Systems are commonly used on MOOC platforms. Learners match their own photo with an ID document such as a passport, national ID, or driving licence (Witthaus et al., 2016). FutureLearn, Coursera, and Udacity use NetVerify as a third party for verification.

This form of verification usually happens once, at the beginning of the registration process. One exception is edX, which verifies identity annually. EduOpen does not use online verification but uses ID checks at the university when qualifications are physically handed to learners. Udacity, by contrast activates, ID verification once learners submit an assessment and uses an exit interview as an extra step of ID verification.

This can be considered a basic practice because, although a

minimum authentication level of ID verification is offered, it does not confirm identity at the point of assessment and is not tied to a specific assessment scenario. It is an authentication method which does not offer authorship verification.

### **Registration at a Higher Education Institution**

Some study programs require learners to formally register with the university as non-degree students, providing another layer of ID verification. This example is used on FutureLearn, for example, on Business and Finance Fundamentals and The Digital Economy from The Open University and Causes of Human Disease: Understanding Causes of Disease and Discovering Science from the University of Leeds. This is also considered a basic practice because it provides a second layer of authentication but does not confirm authorship or confirm identity at the point of assessment.

### **Proctoring an Exam**

The online proctored exam is a method of ID verification used by edX, FUN, FutureLearn, and MiriádaX. Learners are required to set up proctoring software before sitting a final exam. This software monitors the computer screen and uses the webcam to monitor learners. Proctoring is typically used only for exams and not for assignments or other forms of work. It adds another layer of verification and helps to guarantee the authenticity of assessment. However, it cannot provide a guarantee that the student has not cheated or plagiarised work.

### **Random Proctoring**

Random proctoring uses software to take pictures, with the learner's agreement, throughout the examination. Afterwards, the biometric system compares these images with a picture already submitted, and also checks for non-permitted activities such as talking, reading, or leaving the room. Images are sent to the instructor. Students may complete the exam successfully but fail on the basis of the biometric result. MiriádaX used Smowltech software to apply this approach on the Expert in PPP Contract Management final exam. While this example is scalable and provides another layer of verification, it is not foolproof and MiriádaX is currently reviewing alternative tools.

### **Full Proctoring (Live)**

Full live proctoring uses software to observe learners taking an exam. This approach is used on the FUN platform, with the aim of replicating the exam experience on traditional university courses. An online reviewer monitors the assessment. At the start, students show their surrounding environment to demonstrate the absence of materials that would help them to answer questions. Their activity is then streamed via webcam and computer audio. This method involves matching an online reviewer with a learner and securing a stable internet connection; the learner could be disqualified if the connection is lost. Some MOOC platforms that were interviewed in the course of the study said that they were discontinuing their use because learners felt uncomfortable about being watched and this potentially affected their performance.

### **Full Proctoring (Recorded)**

Recorded exam sessions are currently proctored after the event on edX, FUN and FutureLearn. The monitor notes whether an instructor needs to examine the recording at certain points. This approach allows learners to take their exams at times convenient for them and offers a reliable and scalable alternative to live proctored exams. This flexibility is undoubtedly appreciated by learners and educators, though there exists a gap in the research literature regarding the comparison of synchronous and asynchronous proctoring in terms of learner performance.

### **Interviews**

The authenticity and authorship of learners' work can be validated in an onsite or online interview. Alternatively, learners may be asked to record a video to demonstrate knowledge in relation to certain learning outcomes. This approach adds a layer of verification, with a focus on authenticity, at the point of the assessment. However, it is arguably the most demanding in terms of cost and time and relies to some extent on the personal judgement of the interviewer.

#### **Interview: On Site**

At EduOpen, once learners finish a course, they are interviewed on university premises and their identity verified. This method is considered reliable in terms of authenticity and authorship. EduOpen is required to take this as it falls within the wider Italian national system, but it would be difficult to scale due to cost, time, and geographical limitations. In the age of the Covid-19 pandemic, face-to-face interviews are especially problematic.

#### **Interview: Online**

Online validation interviews are used on Udacity's Nanodegrees and on some edX Micromasters. A short interaction with an educator is used to validate a student's identity and work. On Udacity, learners verify their identity after passing an exam and are often prompted to schedule an exit interview, which takes less than five minutes. One example is The Associate Android Developer Fast Track Scholarship Program, where learners are asked about the exam project (Hidayat, 2017).

edX Micromasters courses that use interviews to verify identity include Instructional Design and Technology from University System of Maryland. Learners complete a capstone project, which includes designing and developing an online course. They then schedule a 10-minute interview using videoconferencing software in which they are asked about the decisions they made and also discuss course content.

#### **Interview: Recorded Presentation**

Assessment on the Corporate Innovation Micromasters developed by the University of Queensland includes an oral presentation, used to verify authenticity and authorship of work. Like the interview method, this method combines ID verification with assessment. Asking learners to record a presentation goes some way towards establishing authentication and authorship. However, in live interviews, students can be asked questions that directly verify authenticity and authorship; in a pre-recorded submission, it is possible that a candidate could be reading a script written by someone else.

Nevertheless, recorded presentations are often considered better practice than live interviews as they give learners more

space for trial, error, and creativity. They provide a better medium for learning and a relatively trustworthy layer of verification. In addition, they increase flexibility for learner and assessor, removing time limitations and the pressure of the moment.

**Potential Good Practice: TeSLA System**

TeSLA is a project funded by the European Commission to develop a system for trust-based authentication and assessment of authorship. Using this system, authenticity and authorship can be verified across different e-assessment scenarios (Mellar, 2016). This is achieved through different software capabilities (Knuth, 2016), including:

1. Face Recognition: analyzing visual data such as images and videos and recognizing a face within the data.
2. Voice Recognition: analyzing and verifying the learner’s identity by comparing characteristics of the voice within the data.
3. Plagiarism Checks and Authorship Validation: detecting word-for-word copies in sets of documents.
4. Key-stroke Patterns: recognizing patterns based on the times of press and release on keys when typing on a keyboard.

In the TeSLA system, an instructor sets an activity and selects a verification instrument from the set above. The learner agrees to the use of this instrument and provides input to the system. This is used to build a model that will be used for verification. The learner completes the activity and submits it via TeSLA, which produces a report the instructor can use to verify authenticity and authorship.

TeSLA provides identity verification for various forms of assignment at the point of assessment (unlike proctoring, which is only used for exams). The use of technology means it can be scaled more easily than human-based methods of verification. Concerns about this system relates to the privacy of learner data once it has been collected, and the TeSLA project devoted considerable effort to the legal and ethical aspects of this (Mellar, 2016). The TeSLA project is currently running pilots with three universities, but the system has not yet been implemented on any MOOC platform. However, it is potentially a better practice than many currently in use.

**Methods of recognition**

Recognition refers to the award that students receive on successful completion of a study program. Programs aligned with the CMF provides a transcript that specifies course content, learning outcomes, total study hours, level on the European Qualification Framework (EQF) and the number of academic credit points (ECTS) earned. Table 2 provides a summary of the recognition methods currently in use.

**Table 2: Summary of recognition methods**

| Main Category              | Sub-category     | Brief Description   |
|----------------------------|------------------|---|
| <b>Academic Credit</b>     | Non-transferable | Academic credit can only be applied to a program offered by the same university.  |
|                            | Transferable     | Academic credits can be transferred, either because ECTS are awarded or because specified universities have agreed to accept the credits. |
| <b>Professional Credit</b> | Formal           | Awards credit hours or credits from formal professional accreditation bodies.   |
|                            | Informal         | Informal awards such as a certificate from the MOOC platform or badge from content provider   |
|                            | Endorsement      | Professional certificate backed by business leader, enhancing credibility and increasing work relevance.                                  |
| <b>Combined</b>            | Combined         | Academic and professional credits awarded. Increases utility for learners.  |

**Quality Assurance Processes and Awarding Credit**

It is crucial for trust in qualifications that providers demonstrate to accrediting bodies that they are following appropriate quality assurance (QA) processes. In addition to internal QA processes, they must demonstrate they are adhering to the quality standards set by accrediting bodies. The different standards directly impact practice when awarding academic or professional credit. For instance, UK universities must meet the national qualification standards set by the Quality Assurance Authority (QAA). The QAA code includes: expectations, core practices, and common practices, all supported by advice and guidance. Expectations are objectives that providers should reach after setting the standards and managing the quality of their awards. Core practices are effective ways of working. Scottish providers also adhere to SCQF (n.d.) quality standards in order to award academic and professional qualifications. So, even within the UK, there are manifold pressures. There is some convergence of approach evident in Europe, but this does not travel to other contexts in obvious ways. Micro-credentials in New Zealand, for instance, follow NZQA quality standards, which integrate initial QA with ongoing self-assessment. The NZQA (n.d.) adapts the Te Hono o

Te Kahurangi QA approach, which includes six policies that help educators undertake evaluative conversations.

### **Academic Credit**

Academic recognition is given when a learner is awarded academic credit, which varies according to the length and level of the program. (The CMF specifies the award of 4-6 ECTS per micro-credential.)

#### ***Non-transferable Academic Credit***

Some universities offer academic credit that can only be applied to a program offered at that university. These credits cannot be transferred without appropriate work on credit transfer. This practice is applied across all FutureLearn's academic programs, on Coursera's MasterTrack certificates, and is often the case on edX.

FutureLearn offers several programs that offer academic credit. For example, The Open University's Business and Finance Fundamentals is accredited using the Online Course Certification System (EOCCS). Those who complete it successfully are awarded 30 UK credits (300 study hours) towards the university's Business Management BA degree. The Digital Economy awards 15 UK credits (150 study hours) towards the university's MBA.

Coursera also offers non-transferable academic credit. Successful completion of the Machine Learning for Analytics MasterTrack from the University of Chicago enables learners to fulfil 18% of the requirements of the University's Analytics MSc. Successful completion of the Supply Chain Excellence MasterTrack from Rutgers University earns students three credits on the Supply Chain program at that University.

This approach is also used on edX. Successful completion of the Business Fundamentals Micromasters program from the University of British Columbia earns learners six of the 31.5 credits needed for the Master of Management degree at that University. Non-transferable academic credit arguably has value for students, but failure to offer flexibility could be a barrier for some.

#### ***Transferable Academic Credit***

Transferable academic credit is more flexible and is used on the edX and EduOpen platforms. An edX example is the Supply Chain Micromasters program from MIT. Successful completion of this program can help students apply to 18 universities worldwide, where they can use the academic credits they have earned. Also, at edX, successful completion of Managing Technology and Innovation from RWTH Aachen University gains a student 15 ECTS that can be transferred and recognized across Europe.

EduOpen offers Unità di Credito Formativo (CFU), the Italian equivalent of European ECTS credits, on its academic pathways. The Content and Language Integrated Learning pathway offers 16

CFUs that can count towards a master's degree from Università Di Foggia and other universities that accept the transfer of these credits.

Transferable credits give learners freedom of choice if they want to study at another university or in another region. However, awarding and guaranteeing these credits involves administrative work which is likely to result in higher costs.

### **Professional Recognition**

Professional certification is another form of recognition. European MOOC platforms, especially FutureLearn, usually offer formal recognition in the form of continuing professional development (CPD) hours or formally accredited programs. US platforms Coursera, edX, and Udacity offer more informal awards such as certificates and badges. At present, platforms in the USA are more likely to have their programs endorsed by leading businesses than their European counterparts. This is perhaps intended to balance the lack of formal accreditation awarded by professional societies and accreditation bodies.

#### ***Formal Recognition and Accreditation***

Some courses offer formal recognition in the form of professional credit hours or accreditation awards. This practice is most common on the FutureLearn platform and is occasionally observed on Coursera and edX.

The University of California Irvine (UCI) offers a Professional Certificate for Project Management on Coursera. Successful completion of the program earns learners 120 contact hours that can be used to meet The Project Management Institute's educational hours requirement. The TESOL professional certificate provided by Arizona State University offers a 150-hour TESOL certificate on successful completion. The University System of Maryland professional course on Spiritual Competency Training in Mental Health awards six Continuing Education (CE) credits for successful completion on edX. FutureLearn offers formal professional accreditation across all its professional programs.

#### ***Informal Recognition***

Other professional-development courses offer informal awards such as certificates from the MOOC platform or badges from the content provider. A badge is an image that can be displayed online, containing a hyperlink to evidence that award criteria has been met (Cross, Whitelock, & Galley, 2014). Informal recognition is common on Miriadax and the US-based platforms Coursera, edX, and Udacity.

On Coursera, professional certificates are usually awarded by programs offered by business leaders. The majority are provided by IBM, Google Cloud, and SAS. A certificate is offered following successful completion of the program. IBM professional

certificates offer an IBM Digital badge. After completing the IBM z/OS Mainframe Practitioner Learning Path, for example, learners are awarded a digital badge for each course. Similarly, edX offers informal recognition at the end of its professional certificate program, and Udacity learners receive a certificate of achievement after completing a nanodegree program.

On successful completion of the Miríadax's program, Expert in PPP Contract Management learners receive are certified as 'Expert in Contract Management of Public-Private Associations' by the Development Bank of Latin America. Informal recognition is common across MOOC platforms, yet it is not established as credible for learners or employers compared with a formal accredited award.

### **Endorsement**

Informal awards can be complemented by endorsements from leading businesses. Endorsement gives awards more weight and enhances their reputation. There are several examples of endorsements on edX and Coursera.

On edX, many professional certificates are endorsed by a senior professional from a business leader, or the programs are offered by a business leader. The Professional Certificate in Corporate Finance from Columbia University is endorsed by a senior product manager for LinkedIn; the Professional Certificate in the Science of Happiness is endorsed by the Manager of Corporate Social Responsibility and Community Relations at LG; and the Professional Certificate in Python Data Science is offered by IBM and endorsed by the CTO and Director Emerging Technologies at IBM.

Coursera offers programs from leading businesses, including SAS, IBM, Google Cloud, and (ISC)<sup>2</sup>. An example is the Google IT Professional Certificate by Google Cloud, recognised by a large hiring consortium that includes the Bank of America, GE Digital, Intel, The Home Depot, Walmart, and Google. Endorsement from a leading business can enhance the credibility of informal professional credits.

### **Combinations of Academic & Professional Recognition**

Some programs offer both academic and professional credit. Examples on FutureLearn include Causes of Human Disease and Environmental Challenges from the University of Leeds. These programs offer 14 CPD credits in addition to the academic credit awarded on successful completion. Also, on FutureLearn, successful completion of Genomics in Healthcare from St. George University gains learners 35 CPD credits from RCPATH and 10 RCGP learning hours as well as academic credit.

On Coursera, the Google IT Professional Certificate by Google Cloud mentioned above can earn learners academic credit and a

professional certificate. They earn a credit recommendation from the American Council on Education (ACE) ACE CREDIT®, which transforms professional learning into college credit. On successful completion, learners earn a recommendation of 12 college credits, equivalent to four college courses at associate degree level. This approach offers value for learners as it is flexible and relevant for both employers and employees.

### **Assessment**

Assessment is traditionally the documentation of metrics that determine the success of educational interventions.

#### **Summative Assessment**

Summative assessment evaluates what a learner has achieved after a period of study. It typically relates to a program's learning aims and may be carried out in accordance with a national or international qualification framework. MOOC platforms have two broad approaches to summative assessment; they use a single type or combine multiple types. The different approaches are summarised in Table 3.

#### **Computer-graded assessment**

Computer-graded assessments are commonly used, particularly on programs offering professional recognition. This is a scalable and efficient approach to summative assessment that reduces the costs of marking, and provides opportunities for instant feedback (Laurillard, 2015). Multiple-choice tests allow teachers to evaluate the performance of groups and individuals. However, computer grading is currently not capable of evaluating certain concepts and skills (Laurillard, 2015).

Final proctored exams, discussed above as an ID verification practice, are commonly used. Final timed and proctored exams are used by NYIF across its seven programs on edX and FutureLearn. Each examination includes up to 70 MCQs and lasts up to two hours. MCQs are also used for summative assessment by EduOpen, for example on their program Enabling and Rehabilitating Approach to Sensory Disabilities – Introduction to Sensory Disabilities. Computer-marked exams are scalable because the cost per student goes down as the number of scripts marked goes up. Although MCQ tests can give students instant results, depending on them for summative assessments reduces opportunities for students to receive in-depth feedback.

Another approach is to use MCQ quizzes based on projects or case studies. This method is commonly used on Coursera's technical professional certificates, such as the SAS Programmer Professional Certificate and the Data Engineering with GCP Professional Certificate. Combining computer-graded assessments with the use of artificial intelligence to detect code



**Table 3:** Approaches to summative assessment

| Main Category                 | Sub-category   | Examples   | Advantages  | Disadvantages   |
|-------------------------------|--|--|---|---|
| <b>Single-type assessment</b> | Computer-graded  | Final proctored exams, multiple-choice quizzes, computer-graded assignments  | Scalable and efficient. Reduces cost per student. Opportunities for instant feedback. Supports evaluation of group and individual performance | Cannot currently test certain concepts and skills                       |
|                               | Peer-graded  | Peer-reviewed project plan or presentation   | Pedagogic benefit for learners.   | Low rate of student approval. Difficult to apply on self-paced courses. |
|                               | Teacher-graded   | Written assignments, tasks, portfolios   | Offers value through constructive feedback.   | Feedback delayed. Not scalable due to time and cost.                    |
| <b>Multi-type assessment</b>  | Peer-graded assessment and teacher-graded assessment     | Essay self assessed against criteria, then peer-reviewed, then tutor marked  | Time and cost reduced ; chances for feedback increased  | Complex to set up   |
|                               | Peer-graded assessment and computer-graded assessment    | Report on project evaluated by peers, plus MCQs  | Use of AI could allow this to scale. Peer evaluation can provide useful feedback.   | Peer evaluation difficult on self-paced courses                         |
|                               | Computer-graded assessment and teacher-graded assessment | Literature review, recorded video, and final exam. Final exam and online interview. Online test, oral presentation, essay, and live questions. | Robust summative assessment. More chances for students to obtain feedback   | Poorly planned combinations of assessment can cause confusion.          |

bugs allows the program to scale easily, decreasing marking costs. This is an efficient form of assessment. However, reliance on automated grading of MCQs once again reduces opportunities for feedback. Unless MCQs are drawn from a very large question bank, students may cheat by sharing correct answers.

Another approach combines regular assignments with a final proctored exam. This method is used on edX on the Corporate Finance Professional Certificate from the University of Columbia. MCQ quizzes are used with a final, computer-marked exam. Also, on edX, the Introduction to Python Program Professional Certificate from Georgia Tech University combines problem sets with a final proctored exam.

Combining forms of computer-graded assessment increases opportunities for instant feedback. However, complete reliance on computer-based assessment limits the skills and concepts that can be assessed.

### **Peer-graded Assessment**

Peer-graded assessment involves students receiving marks from their peers and marking their peers in return. This approach is commonly used to scale marking at low cost. Good practice is for learners to be trained to grade assignments until the grade that

they give matches the grade given by the tutor; tutors randomly review the grading to ensure quality; and several students grade each assignment to give an average grade. Laurillard (2015) notes a significant pedagogical benefit to peer assessment, however, it is often not highly approved by students (Laurillard, 2014). Moreover, peer assessment is more valid with learners who are trusted to have some knowledge.

The Project Management Specialization developed by University of California, Irvine, on Coursera uses peer-graded assessment. Learners submit a project plan as a capstone project. They receive a mark based on peer assessment by five peers. The Strategic Management Professional Certificate offered by Wharton Business School on edX requires learners to create a presentation, which is then reviewed by peers.

Peer-graded assessment gives students an opportunity to produce authentic and meaningful work and receive feedback. In the process, they critically evaluate other learners' work, reinforcing and reflecting on their own learning. However, this approach is necessarily not trusted as a reliable assessment method. Perceived reliability increases when combined with other types of assessment.

### **Teacher-graded assessment**

Teacher-graded assessment does not always scale well because of the time and cost involved in marking but is often applied to essays and capstone projects. There are several examples on FutureLearn. Management and Leadership Essentials – Management and Leadership, Personal Development from The Open University (UK) includes an assignment made up of six writing tasks. Tutors grade these and provide constructive feedback. The Managing People program ends with a 1,500-word assignment and students receive feedback on this from Henley Business School at the University of Reading.

On Coursera, the TESOL Professional Certificate on Coursera offered by Arizona State University includes two capstone projects, building a portfolio of artefacts. This portfolio is submitted for expert review in order to be awarded the 150-hour TESOL certificate. Udacity's nanodegrees include project-based summative assessments. A portfolio showcases technical skills acquired by learners. Experts assess these and provide personalised feedback.

Teacher-graded assessment offers value to learners by providing constructive and developmental feedback. However, learners have to wait for this, and the time and cost involved makes this approach difficult to scale.

### **Hybrid Approaches: Peer-graded Assessment and Teacher-graded Assessment**

Peer-graded and teacher-graded assessment are combined by the University of Leeds for three programs hosted on FutureLearn. In week one of a summative assessment, students self-assess their work against an example answer using marking criteria. The next week, they refine their work and undertake a peer-review process using the same grading criteria. In the final week, they refine their work again and submit it for final tutor grading. This approach uses self-assessment and peer-assessment to familiarize students with grading criteria and provide feedback before final submission. Learners have opportunities to improve their work and refine their final submission, raising their chances of success and making final marking easier. There are multiple opportunities for feedback, and the time and cost per student are lower than if all assessment were done by an academic.

### **Hybrid Approaches: Peer-graded Assessment and Computer-graded Assessment**

IBM combined peer-graded and computer-graded assessment on its professional certificate offerings on Coursera and edX IBM Applied AI, IBM Data Science and Python Data Science. During capstone projects, learners worked through MCQ quizzes and submitted a project report.

### **Hybrid Approaches: Computer-graded Assessment and Teacher-graded Assessment**

Computer and teacher grading are combined in several ways. For the Introduction to Psychology program offered by Monash University on FutureLearn, learners record a video and submit a literature review for teacher grading, then complete a computer-marked exam that covers the concepts of the program.

On Sustainable Energy, offered by Queensland University on edX, learners sit two online proctored exams and participate in an online Zoom meeting. On the university's Corporate Innovation program, learners take a computer-graded online test, prepare an oral presentation and a written essay, and present a live oral pitch followed by questions and answers with faculty members.

## **CONCLUSION**

This paper reviewed state of the art approaches to ID verification, recognition, and assessment in MOOC. There does not appear to be a universal approach or solution to the challenges of verifying student identity or ensuring examinations or assessment have been completed by the enrolled student.

There is, however, emerging coordination of recognition (e.g., endorsement or formal accreditation) of participation/ completion of online courses but for this to be meaningful at scale, it is dependent on engaging with and coordinating efforts across a range of stakeholders including businesses, universities and employment services at the national and international level. Projects such as BizMOOC and the CMF launched by the EMC are being recognized more universally, but many others remain siloed.

There is a tension here which goes back to the original conceptual and practical dichotomy between xMOOC and cMOOC, and their respective understandings of "open" in online education. The competitive and commercial nature of many xMOOC platforms prohibits the kind of transparency and data sharing that expedite a "joined-up" approach.

A diverse range of assessment techniques are currently being deployed by the MOOC platforms reviewed, ranging from human (peer, teacher) to automated assessment and combinations thereof. However, significant challenges remain including being unable to test certain skills via online means and student preference for specific feedback mechanisms (e.g., peer review). Moreover, student preference for individual teacher feedback despite delivery at scale is difficult to reproduce. In addition to that reported in the state of the art, some online courses have deployed assessment models which provide individual feedback from others, e.g., past participants or a group of educators who support students in smaller cohorts, alongside the main course facilitators. The time and resource required to evaluate work and support

learners is therefore spread over a larger number of persons. However, this remains a resource intensive option and reliant on sufficient uptake of facilitators—and potentially volunteers.

Four methods of ID verification were highlighted in the above review: basic ID checks, checks made by the university, proctoring and various types of interview. There is no systematic or standardized approach to how or when ID verification takes place or in what context (e.g., during examination). Projects such as TeSLA are aiming to test these approaches more consistently across a course's lifecycle and will perhaps generate a template that could be applied to other types of online learning. The norm currently remains replication of face-to-face methods of ID verification and there remains a significant tension between learner expectation and prior experience and the limits of current technology. Considerable ethical concerns, particularly around privacy and data protection remain and the use of third-party software could also be of concern, particularly in relation to proctoring. Proctoring remains controversial and there remains a need to robustly survey ID and assessment approaches prior to implementation whilst working with students to better understand the viability of different approaches.

In relation to recognition, few examples showcased in this paper draw on existing research in these areas. For example, research on the use of multiple-choice questions, computer-aided assessment and e-portfolios have not yet influenced the practice reviewed in this state of the art despite being long established in e-learning. Similarly, plagiarism checking software such as TurnItIn or Copycatch is routinely used by higher education institutions around the world to verify that students have not copied the work of others, yet hardly used at all on MOOC platforms.

The pedagogical approach(es) employed by platforms should also be reviewed, particularly to encourage more innovative and sustainable ways of assessing student work and participation in a course. This could result in more robust frameworks for ethical and sustainable approaches to online ID verification and assessment. Other challenges for current ID verification methods (and also modes of assessment) include scalability, support for students and scoping.

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