

# The Search for the MOOC Credit Hour

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**Abstract**— Over the past decade, MOOCs have risen to prominence in part because most do not carry heavy requirements regarding accreditation, scope, and evaluation. While this has allowed MOOCs to proliferate, it has led to difficulty understanding what completing a particular MOOC means. Individual MOOCs can vary tremendously in their quantity of content, their depth of assessment, and their mechanisms to ensure academic integrity. In order for MOOC credentials to have value in academia and the workplace, however, there must be some trust in what a particular credential means about the learner. In this work, we perform a study to understand the variety of MOOCs available, then propose a MOOC Content Matrix as a short, objective way to summarize what a particular MOOC entails and, in turn, what value its certificate gives.

**Keywords**— MOOCs, credit hours, online education

## I. INTRODUCTION

What does completing a MOOC mean? Much of the value and interaction in higher education is built on the perceived equivalence of different constructs, like the Bachelor’s degree, the credit hour, and the minor. There exist differences, of course, based on everything from the prestige of the university to its status as public, private, or for-profit, but there exists a cultural vocabulary built around these constructs; they are the first word in the conversation, though not the last.

When MOOCs burst onto the scene at the start of the decade, they carried with them ambitious dreams of revolutionizing and democratizing higher education, driving down the cost of tuition, and opening up content to the masses. To achieve this goal, some would argue that MOOCs need to connect to the existing constructs of traditional universities. Others argue that MOOCs can be more disruptive, defeating the very notion of a Bachelor’s degree. How do MOOCs connect to this debate? When a student states that they completed a particular MOOC, what exactly does that statement say about the student’s educational attainment? What does completion of a MOOC mean?

### A. *The Beginning of MOOCs: The Wild West*

To understand the context of this question, we must first step back and understand how MOOCs’ connection to this conversation was severed in the first place.

For all competing perspectives on the effectiveness of MOOCs, it appears evident that they succeeded in making content more available: in the past decade the number of students enrolled in MOOCs has surpassed 110 million. Over the years, ongoing enrollment trends have made it clear that availability of content was only one piece of the puzzle. Students wanted certificates: a key part of completing a course, whether it be for-credit at a university or as part of a MOOC, was to be able to demonstrate to schools or employers evidence of the skills and knowledge obtained [4][10].

Part of the reason the MOOC landscape was able to grow so quickly was that MOOCs launched without the traditional trappings of accreditation: there were no admissions, courses were not worth credit, and “tuition” was paid to the MOOC providers as intermediaries rather than directly to the universities. As such, the mapping between MOOCs and on-campus courses did not need to persist. MOOCs did not need to offer equivalent endorsement of student ability or congruent content to a traditional class. This freedom played a key role in allowing MOOCs to proliferate: individual courses did not need to go through traditional committees and layers of approval in order to be produced. This decoupling also partially explains the wide variety of courses now available, many of which lack a campus analogue.

### B. *Something Gained, Something Lost: The Credit Hour*

The lack of committees and approval processes permitted the number of available MOOCs to swell, but part of the function of those processes was to ensure some consistency across classes, programs, and colleges. The credit hour is the most common measuring stick by which American and many international universities measure the amount of time and effort required to both teach and take a class, and courses are constructed such that a 3-credit hour English class is argued to be roughly comparable (as much as the comparison can be made) to a 3-credit hour Physics class.

Absent those layers of approval, our research shows that MOOCs do not have this mechanism. The result is a wildly varied library of certificates all available under the general header, “Course”. For some MOOCs (as we will see in this analysis), “completion” involves merely marking that every video in a sequence has been watched. For others, there may be written assignments evaluated by peer or expert review, automatically-graded quizzes, proctored exams, or mandatory forum participation. Some courses consist of less than an hour of video content; others may require dozens. Some courses require only assessments that can be brute-forced until correct; others offer more traditional assessments that can be failed.

### C. *The Problem*

The resulting MOOC landscape brings us back to the original question: what does it mean to complete a MOOC? The answer is: it depends heavily on the MOOC. How long was it? What were its assessments like? Was it self-paced or did it impose challenging pacing requirements? Credit hours attempt to standardize answers to questions like these in for-credit classes. While they do not resolve all of the difficult problems in making such comparisons (how do you compare a Computer Science class to a Poetry class?), they at least provide a starting point to have a conversation around what commonalities should exist as far as time expectations, lecture hours, and contributions to a degree program. Credit hours and similar constructs provide a vocabulary in which conversations can occur about educational attainment.

The variety inherent in MOOCs makes it difficult to use MOOCs in these conversations. In the absence of personal familiarity with the course, it is difficult to know what perceived accomplishment ought to be attached to the completion of a particular MOOC.

This presents two major challenges: first, while there have long been efforts to create credit-worthy MOOCs, the success stories are limited and specific to individual programs and universities. To realize the democratizing goal of MOOCs, it would be valuable to have a way of understanding more broadly how any given course that is developed fits into the overall landscape.

Second, if MOOC certificates are to have value even outside of counting toward university credit (for example, as resume items or on college applications), there must be an available understanding of what the certificate actually implies about the student's ability. For-credit courses provide this understanding through the mechanisms of accreditation and credit hours; to fulfill a similar function, MOOCs would benefit from a similar mechanism.

#### *D. A Solution: The "MOOC Credit Hour"*

These problems bring us back to the idea of a credit hour. The "standard candle" for effort in course work has been the credit hour. The credit hour is a relatively standardized measure of the amount of work that a course requires. This (coupled with grading) is used as an indicator of achievement and progress towards the completion of the degree. We argue that there would be value in a so-called "MOOC credit hour", a mechanism for understanding the relative value to attach to different MOOCs. Here, we use "value" to encompass a variety of criteria, including the scope of the content, the discriminability of the assessments, and the reliability of measures to ensure academic integrity.

There are multiple ways this could be created; one approach to MOOC quality assurance is a ranking of courses based on evaluations from learners and educators—in essence a "league table" [3]. Social media could also be a powerful quality assurance mechanism as courses improve in response to provider and user commentary [9]. This sort of approach can already be seen in existing MOOC-review sites, such as ClassCentral.com. These approaches have weaknesses, though; the first is very work-intensive, presenting a challenge to the scale that MOOCs strive to achieve. The second puts responsibility for evaluation in the hands of novices, who may not be well-suited to evaluate the quality expert-produced content.

In this work, we examine whether a third mechanism could exist, an objectively-derived summary of course content in terms of numeric criteria that could be derived automatically or semi-automatically. Such a mechanism would not itself be superior to the above, but rather would be another tool to use in evaluating the level of accomplishment or knowledge acquisition that should be attached to completion of a particular MOOC.

In the primary contribution of this work, we analyze the current MOOC landscape to better articulate its wide variety. In doing so, we provide a picture of how radically different the accomplishments measured by specific MOOC certificates can be and share a preliminary proposal for what ought to factor into a "MOOC credit hour".

## II. THE FUTURE: SEEKING A MOOC CREDIT HOUR

We want to create a mechanism that can be used to assign credit-worthiness to existing MOOCs. Credit-worthiness, to us, does not necessarily mean that the course must count for academic credit, but rather that it must also fulfill the function of for-credit courses: providing a trustable assessment of the student's achievement. We seek to provide a mechanism that can be applied to all courses. Most importantly, we seek a mechanism that can be performed at scale, not one that requires onerous committees and panels to evaluate and endorse courses one-by-one.

Of course, we make no claim that such a mechanism could be the be-all-end-all endorsement of the credit-worthiness of a particular course; rather, it would be one useful, attainable, accessible feature that could be used to quickly filter or guide attention to the most potentially credit-worthy courses.

### *A. Study Methodology*

In order to begin devising this mechanism, we performed a study looking at a cross-section of the current MOOC landscape. There are three goals of this study; first, we identify those criteria of MOOCs that are common and objectively measurable, such as quantity of video and types of assessments. Second, we establish a range of observed values within these mechanisms, to understand what constitutes an "average" MOOC. Third, we attempt a target for assessing the credit-worthiness of a course in terms of these objective metrics.

#### *1) Definition of Common Parameters*

The first step of this process involved articulating common parameters observed across a wide range of MOOCs. We conducted an initial survey semi-randomly selecting thirty MOOCs from five platforms: Coursera, EdX, FutureLearn, Iversity, and Kadenze. These platforms were chosen due to their university affiliations; these university affiliations carry an implicit endorsement of the course material (insofar it is valuable to know that a particular university is willing to have a MOOC identified as its own content). The mechanisms we devise could ideally be applied to more vocational platforms like Udemy and Udacity where such an implicit endorsement does not presently exist.

The goal of this step was the identification of objective parameters that are common between candidates to be included in the comparison of MOOCs. These 30 courses were subdivided among six researchers; five of these six researchers evaluated courses from single platforms, while the sixth looked at one course from each of the five platforms. This would allow for a deeper understanding of the parameters available on each of the five platforms, without loss of cross-platform visibility.

Within each platform, course selection was semi-random; researchers selected courses immediately available either via the home page or a quick search in order to ensure that semi-deprecated or obsolete courses were not selected as may occur with a pure random selection. The goal of this portion of the study was to identify common characteristics rather than general claims about all courses, and thus we argue this semi-random approach is sufficient.

The analysis of the original thirty courses from the five platforms yielded some common higher-level measurable

TABLE I. OBJECTIVE PARAMETERS

Metric	Description
<b>Context</b>	
Platform	Which platform provides the course
Provider	Which university provides the course
Cost	The price associated with the course's certificate (if applicable)
Hours	The platform's recommendation for number of hours to complete (either given or derived from hours per week $\times$ number of weeks, using the midpoint if ranges are used)
Program	The larger program in which the course resides (if applicable; e.g. a course may be part of an Xseries, MicroMaster's, etc.)
<b>Volume</b>	
Video	Total minutes of video present in the course
Transcript	Total number of words present in the course transcripts
<b>Evaluation</b>	
Assessments	The number of each kind of multiple assessments (e.g. number of limited-attempt quizzes, number of infinite attempt practice quizzes, number of written assignments, etc.)
Engagement	Whether or not the course requires learners to engage with one another for course credit (e.g. required discussion assignments)
<b>Integrity</b>	
Proctoring	Whether or not the course uses proctoring to verify student identities on tests or other high-stakes assignments
Plagiarism	Whether or not the course employs plagiarism-checking tools to ensure assignment authenticity
<b>Reputation</b>	
Reviews	The number of learner-provided reviews on a course review site, e.g. ClassCentral.com
Rating	The numeric rating derived from those learner-provided reviews

parameters such as the cost of any certificates offered, the total minutes of video-lectures available, the number of words in the video transcripts, the total university-provided estimated time to complete, the number of assignments, and student reviews.

Deeper analysis was done with the utilization of the aforementioned high-level parameters with a deeper level of granularity. This generated the list of objective parameters that may be used to summarize a MOOC shown in Table 1.

## 2) Data Collection

In the second phase of the study, we collected data on other courses as well. These data were used as input into a table of 36 parameters (after breaking out some of the

parameters in Table 1 into sub-parameters like number of quizzes, number of exercises, etc.).

For the second collection of courses, we selected classes from the recently published Class Central list of 100 most popular MOOCs for 2019. This metric is obviously imperfect as it oversamples good courses; however, other sampling methods we considered featured their own weaknesses. Most significantly, given how rapidly MOOCs and MOOC platforms change, we wanted to make sure to avoid developing metrics that are immediately outdated because they are based on MOOCs that are themselves obsolete. Original launch date information is difficult to come by on all these platforms as well. We considered oversampling popular courses to be the most tolerable of all drawbacks; we would argue it would be useful for the mechanism to compare courses to the best and most popular courses.

Courses inaccessible for one reason or another (strictly behind a paywall, not currently open for new enrollments, etc.) were skipped. In total, this process added 48 courses to the 30 analyzed during the first phase. Because we are not attempting to draw strong, generalizable conclusions about the average MOOC, but rather to make broader statements about the range of MOOCs, we generally include both sets in this analysis.

Altogether, this sample includes 36 courses from Coursera, 16 from FutureLearn, 15 from edX, 6 from Iversity, and 6 from Kadenze. 56 universities are represented; only one contributes more than 3 courses (University of Michigan with 7; in the first phase, we included Python for Everyone as one of our courses, then realized it constitutes multiple courses). 12 countries are represented among these universities: the United States (40 courses); the United Kingdom (12); Canada (7); South Africa (4); China (3) and the Netherlands (3 each), Russia, Spain, Germany, and Australia (2 each); and India and Italy (1 each).

Given that MOOCs often tend to overrepresent computing fields, we also checked the distribution of fields in our categorization. We attempted to categorize all the courses, but many defied a conventional categorization; courses like "Learning How to Learn", "A Life of Happiness and Fulfillment", and "Moralities of Everyday Life" do not fit cleanly into topic areas like "Science" and "Math", unless the "Humanities" category is expanded so broadly as to become meaningless. However, in labeling computing courses, we did find they do not dominate the list: 18 of the 79 courses are in computing or programming. Other fields include the arts, business, economics, engineering, foreign languages, writing, math, medicine, and history.

## B. Results

In terms of defining heuristics for a potential mechanism for objectively evaluating MOOC credit-worthiness, we divide our observations into two categories. First, there were six features for which nearly every course could be evaluated, and thus for which some general guidelines can be supplied for what ranges exist and how one course may compare. Second, there were a number of features for which the vast majority of courses lacked altogether, and therefore a course that includes those elements ought to receive notable recognition.

### 1) Common Features

The six features identified as existing in almost every course were: the certificate cost, the number of minutes of video, the number of words in the video transcript, the projected number of hours to complete, the number of quizzes, and the total number of assessments. The boxplots in Figure 1 below show the distribution of these values. We also observed from histograms constructed based on this data that these metrics may follow a rectified Gaussian distribution. This is reasonable due to the non-negative quantities the metrics denote truncating at 0. This is essentially a form of censoring on the lower bound of the interval  $(0; \infty)$ .

These histograms show the wide variation present across many of these metrics. While the majority of certificates cost ~\$50, a handful are enormously higher, despite still falling under the label of a “course”. Hours to complete varies tremendously as well; 4 courses can be completed in under an estimated 5 hours, a number too low to reasonably be considered a “course”. Meanwhile, an equal number estimate they require greater than 100 hours to complete, matching the approximate scope of an on-campus for-credit class. As noted before, the goal here is not to conclusively state, for example, that there are an equal number of <5 hour courses as >100 hour courses, but rather to observe and to demonstrate that there exist courses generating certificates for similar costs and with similar appearances requiring vastly different levels of effort. For example, Georgia Tech’s Mechanics of Materials I course on Coursera is estimated to require 63 hours, and its certificate costs \$49. McMaster University’s Mindshift is estimated to require 10 hours, and its certificate also costs \$49. Even on the same platform and the same price point, the relative demands of a course vary tremendously.

In terms of number of assessments, many courses in our sample actually require no true assessments; under this definition, we consider a true assessment to be one that can be failed. Others have a small number of end-of-chapter quizzes, while others build assessment more deeply into the structure of the course. Here, the variation in number of

assessments is only part of the picture: the greater variation comes in the varied different types of assessments, from peer-reviewed essays to automatically-graded projects to multiple choice and fill-in-the-blank quizzes to proctored, timed tests. In evaluating the approximate value of a MOOC, knowing what kinds of assessments it requires to earn a certificate is essential, and yet this detail is relatively opaque unless the evaluator has personally taken the course.

No metric uncovers the incredible range of scope in MOOCs than the measurement of quantity of video and transcript length. While video quantity is not a perfect (nor even an ideal) measure, it is objective and automatically calculable, and it does provide useful information.

In our sample, 9 courses offered fewer than 2 hours of total video, while 8 offered more than 15. Regarding transcript volume (to control for courses with slower or faster talkers or more liberal editing for dead space), they range from less than 10,000 (4 courses), barely as long as a short story, to over 200,000 (4 courses), longer than Herman Melville’s *Moby Dick*. As noted above, these are courses that generate, to any casual viewer, the same certificate. How is a hiring manager or college admissions officer intended to differentiate whether a MOOC credential on an application is more akin to CalTech’s 18-hour epic “The Science of the Solar System” or the University of Sheffield’s highly specialized 35-minute Forensic Facial Reconstruction?

To be clear: these numbers are not intended to argue that length and quality are interchangeable or even correlated. Rather, this argument is that these metrics are useful to know in evaluating what it means to possess a particular MOOC credential, in the same way it is useful to know whether an applicant’s “degree” is a Master’s degree, Bachelor’s degree, Associate’s degree, or “Nanodegree”.

### 2) Uncommon Features

Other features identified as occurring in the original set of 30 courses were found in the larger set to be very rare among this sample; these include written assignments, projects, case studies, and simulation exercises. Required discussion posts

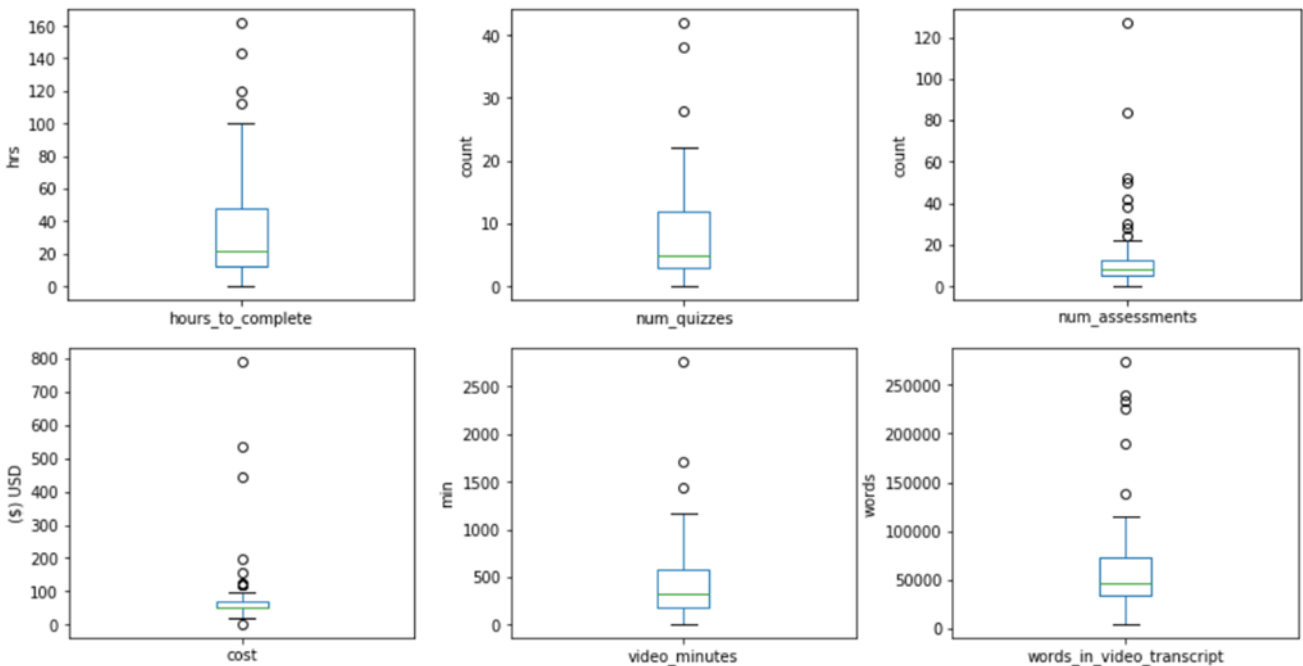


Fig. 1 Boxplots representing the ranges for each of the six identified variables.

and quizzes were found to be present more commonly, although not nearly as ubiquitously as other criteria like videos. These types of assessments, therefore, are held in relatively high regard as ways of differentiating MOOCs requiring more active learning from those offering more passive consumption.

These criteria also connect to a causality dilemma facing MOOCs. If MOOCs have value in the admissions or hiring, then there will exist individuals who want to obtain the value attached to those MOOCs without actually earning the credential (that is, to either cheat [6][8] or game the system [1]). Therefore, to have value, they must take steps to prevent this kind of cheating. For this reason, those MOOCs that require proctoring [7], leverage plagiarism checks [2][7], or adopt a holistic approach to integrity [5] deserve additional acknowledgement.

### C. Discussion

One of our major observations as we wrap up this effort, however, is that the vast range of requirements and criteria in individual MOOCs not only poses a problem for hiring managers or college admissions, but also for us in our attempts to bring structure to a highly unstructured environment. Our examination of these courses uncovered design patterns and assessments that we never anticipated. Subtle differences can have very significant impacts on the overall value one might attach to the completion of a course.

Take, for example, three courses with identical video content and identical assessments, all of which are multiple

choice. The only difference is that one course follows a common standard MOOC model, allowing students to repeat those multiple-choice problems until the right answer is entered. The second course allows unlimited attempts, but throttles re-attempts, allowing students to only attempt problems once per day. A third course limits students' attempts entirely. This subtle change has an enormous impact on the knowledge and effort required to attain the certificate. For the first, a student perceiving the certificate as valuable on their resume could obtain it without consuming any of the content, and yet this is a common structure for MOOC assessments. The existence of MOOCs of this sort further impacts the reputation of all MOOCs; so long MOOCs exist for which certificates are unreliable endorsements of ability, and so long as it is difficult to obtain better understanding of what a MOOC entails, it will be unclear how much credit a particular certificate deserves.

Toward this end, we provide a first effort at creating a mechanism for objectively assessing MOOCs: the MOOC Content Matrix, shown in Figure 2. The MOOC Content Matrix is a short, objective summary of a MOOC's contents that a student could attach to a certificate as a sort of snapshot of what the MOOC entailed, in order to give the reader a better understanding of the value to attach to the certificate. Because it is objective, the Matrix need only be filled out once per MOOC, and then may be shared amongst students. Course staff may even fill it out themselves and provide it as part of the concluding material in the MOOC.

**MOOC CONTENT MATRIX FOR COURSE:** \_\_\_\_\_ COURSE NAME (E.G. CS 100) \_\_\_\_\_

<p><b>Context</b></p> <p>The course was provided by _____  <small>INSTITUTION (E.G. HARVARD)</small></p> <p>It was served through _____  <small>PLATFORM (E.G. EDX)</small></p> <p>It was part of _____  <small>PROGRAM (E.G. THE SUPPLY CHAIN MANAGEMENT MICROMASTERS)</small></p> <p>It cost \$ _____ and had a workload of _____ hours/week.  <small>ROUND TO \$10 # FROM SYLLABUS</small></p> <p>Based on _____ reviews, the average rating was _____ / _____.  <small># # OUT OF #</small></p> <p><b>Course volume</b></p> <p>Videos totaled _____ # _____ minutes, with _____ words.  <small># FROM TRANSCRIPT</small></p> <p><b>Academic integrity</b></p> <p>The course featured proctoring. <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> N/A</p> <p>The course checked for plagiarism. <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> N/A</p>	<p><b>Course content &amp; evaluation</b></p> <p># of exercise questions: _____</p> <p># of quiz questions: _____</p> <p># of problems: _____</p> <p># of required discussions: _____</p> <p># of essay answers: _____</p> <p># of projects: _____</p> <p># of case studies: _____</p> <p># of other assessments: _____</p> <p># of auto-graded evaluations: _____</p> <p># of peer-graded evaluations: _____</p> <p># of human-graded evaluations: _____</p> <p># of timed evaluations: _____</p>
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Fig. 2 The MOOC Content Matrix, a simple worksheet to attach to a MOOC certificate to provide a snapshot of what value ought to be inferred from the certificate itself.

The MOOC Content Matrix brings together the issues described above. After covering general context (provider, platform, price), it provides a snapshot of the overall scope of the course in terms of video and transcript length; these are not, of course, conclusive metrics, but they are simple and objective ways to gain an initial understanding of the scope of the course. The matrix then moves through those other factors from Table 1: the nature of the evaluations, the presence of integrity-verifying procedures, and the community evaluation of the course (if available). Assessments are further divided into Exercises and Quizzes; in our vernacular, these refer to the extent to which a problem can be “failed”. Exercises are those problems that (a) can be attempted an unlimited number of times, and (b) are reasonably subject to brute force attempts, through tactics like trying every answer or trying every vocabulary word from a relatively limited set.

Quizzes are those problems of similar structure (multiple choice, fill in the blank) but which can be failed, either due to limited attempts, an unreasonably large answer space, or their placement on a timed assessment. We also offer Problems (math problems, simulated experiments, or coding challenges that are to be worked through and subjected to an autograder), Essays, required Discussion postings, Projects, and Case Studies as possible categories based on what we saw. Lastly, we also ask for reports on the number of assessments that are graded by humans, peers, and computers, and the number that are timed, for a comprehensive (though still objective) report of what the course entails.

Again, these are not perfect metrics, as courses could have “projects” that vary in scope and depth as much as the video material itself; however, we believe this is a valuable next step toward bringing more transparency to the meaning of a MOOC certificate.

### III. CONCLUSION

In this work, we have taken two angles on examining the complex relationships between MOOCs and credit, both strong academic credit and fuzzier, more social credit. We find that the history of MOOCs is replete with attempts to attach credibility and value to the courses, but that there are relatively few success stories. Those success stories are largely those instances where universities designed courses from the outset to be more credit-worthy, oftentimes sacrificing some of what made MOOCs appealing in the first place. Moreover, the impact of those initiatives is relatively limited in comparison to mechanisms that could apply to the wide variety of MOOCs available more broadly.

The repeated attempts to solve this problem, however, indicate that a better understanding of the value to attach to MOOCs is nonetheless desired. Toward that end, we performed a study to try to bring to light the extent of that variation, with an eye toward establishing mechanics or metrics that can be scalably applied to at least come to an incrementally better understanding of the meaning behind a particular MOOC. At present, the only way to really understand the value to attach to a certificate is to have personal familiarity with the course; we believe that the MOOC Content Matrix, while obviously not sufficient to determine whether a course should count for academic credit, is nonetheless a way to gauge how much a particular certificate should contribute to needs like college and job

applications, allowing employers to begin trusting these affordable and accessible credentials more thoroughly.

#### A. Limitations

Although it is a tempting way to read this study, this study was not a MOOC census. The metrics devised, while likely automatable, are not yet automatic. We make no claims that the averages and variances are indicative of the over-all MOOC landscape; instead, they offer only a conservative estimate for how varied the landscape may be. We can guarantee it is (by definition) not narrower than we have identified, but it may be far wider, as well as transposed.

We have used only university-affiliated MOOCs due to the perceived credibility already attached to them; this assumption may not be well-founded, although to evaluate it would require teams of expert evaluators, returning to the challenge of establishing scalable metrics. It may be the case that the parameters identified here do not apply fairly to corporate MOOCs, or that there are components of corporate MOOCs that are not captured in this matrix.

#### B. Future Work

As noted, this is merely a first step toward bringing greater transparency to the meaning of particular MOOC certificates. For this effort to have impact, it must be adopted by students and MOOC developers, or it must be automated to generate Content Matrices without manual measurement. Even if these steps are performed, it is an imperfect mechanism, and further efforts should be devoted to bringing even greater understanding to what a MOOC entails. While this could be accomplished via improvements to the courses themselves to generate reports more transparent with regard to the skills obtained, more successful efforts would involve mechanisms that can be applied separately, such as visualizations of course content and structures.

### ACKNOWLEDGEMENTS

With the exception of the first and last author, authors of this paper are listed in alphabetical order; no greater relevance of author order should be inferred. We are grateful to Jake Warner for the graphic design of the MOOC Content Matrix.

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