Taking Stock of MOOCs and Credit Substitutability

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Abstract-Since their inception, MOOCs have had a complicated relationship with traditional models of high-stakes, high-value college credit. Early MOOCs were modeled after forcredit courses but were required to be deliberately differentiated from actual for-credit enrollment. Later MOOCs actively separated from for-credit classes, leaving more leeway to experiment with topic, scope, and audience, albeit without the incentive introduced by a connection to a college curriculum. Since then, though, there have been several efforts to relink MOOCs to some form of heavier credential. In this paper, we take inventory of the current landscape of MOOCs and their varying links to college credit. We draw on the idea of credit substitutability as a way of understanding how far from credit a particular course may be. We articulate multiple factors that contribute to substitutability, including scope, assessment, and integrity. Using these factors, we illustrate a spectrum of credit substitutability in MOOCs that includes large classes in affordable degrees at scale; MOOCs with attached mechanisms for credit exchange like MicroMaster's programs, MOOCs that build on content used for for-credit experiences; and MOOCs offered through international platforms with a clearer focus on inter-university credit exchange.

Keywords—credit substitutability, affordable degres at scale

I. INTRODUCTION

Since their inception, MOOCs have had a complex relationship with academic credit. Academic credit has a long and storied history based around the Carnegie Unit, commonly referred to as the credit hour [21]. A credit hour, generally speaking, can be thought of as a currency that summarizes college course completion for exchange between universities, for conversion into credentials, and so on. Many institutions include the credit hour requirement as a fundamental part of the definition of a degree; for example, Georgia Tech has two requirements for all undergraduate degrees: "A bachelor's degree program must require at least 21 credit hours of upper division courses in the major field and at least 39 credit hours of upper division work overall" and "A bachelor's degree program must require at least 120 credit hours, plus the Wellness Requirement, for a total of 122 credit hours.'

As the credit hour is the fundamental unit out of which higher-level credentials and degrees are built, it is often highly protected: the pathways to earn credit hours are typically heavily guarded and quite involved. Most students earn credit hours via university enrollment, though there exist a small number of other avenues as well, such as dual enrollment programs and advanced placement credit. Some universities are more experimental in how they award credit, with some giving credit for real-world experience; notably, however, credits awarded by these colleges are often not transferrable to other universities.

When MOOCs first started to emerge on the scene, one of the early questions was their relationship with college credit. Three of the earliest MOOCs—Sebastian Thrun and Peter Norvig's Introduction to AI, Anant Agarwal's Circuits & Electronics, and Andrew Ng's Machine Learning—were all modeled closely after their for-credit on-campus counterparts, but students enrolling in the MOOCs were not on-campus students and hence had no mechanism to receive true university credit. In a now-famous story (documented in greater detail in *A Revolution in Higher Education* by Rich DeMillo [1]), Thrun and Norvig were cautioned against giving any certificate that could be interpreted as credit-worthy at Stanford University.

In the near decade since then, a variety of different relationships between MOOCs and academic credit have formed. By and large, most MOOCs have drifted further from credit-worthiness, which has allowed for much greater experimentation and variety, resulting in a course catalog wildly varied in course scope and requirements [26]; nonetheless, other initiatives have emerged that attempt to retain some of the connection to credit-worthiness, either through transfer credit, shared content, or leveraging MOOClike models in for-credit environments. In this paper, we will explore two components of these relationships. First, we discuss those components that are present in traditional academic settings that may be needed in MOOC settings in order to extend some of the benefits of credit-worthiness, such as authentic assessment, assertions of academic integrity, and content scope. Second, we catalog a set of ways in which modern MOOCs and MOOC providers are attempting to provide some connection to academic credit, which we refer to broadly as a spectrum of credit substitutability, which refers to the degree to which a MOOC credential may be considered substitutable for a traditional university credit.

II. COMPONENTS OF CREDIT

As both students and teachers of both for-credit courses online and in-person—and MOOCs, we surveyed the landscape to identify the primary features present in the former category and absent from the latter. While not all of these may be necessary for credit substitutability, some subset likely is. In this section, we delineate these differences as well as speculate on their relationship with credit substitutability.

A. Scope

First, for-credit courses tend to have a particular guaranteed scope to them, which is intimately connected to the credit hours earned in return for that course. Universities tend to offer classes on a set quarter-based or semester-based system (though there are exceptions, such as Western Governors University's flexible degree plans [39]), and the number of credit hours attached to a particular course is loosely representative of how much weekly time is required to devoted to that course's synchronous meetings; a three-credit hour course typically meets for three hours each week. There is thus a relatively formal set of equations that dictate the scope that a particular course must take: it must meet for the duration of the term with its commitment varying only based on the number of credit hours it represents.

MOOCs, on the other hand, can be far more varied; most MOOCs now list their estimated time commitment on their home page, but have full control over not only the amount of time the course is expected to take, but even the units of measurement. Courses may self-summarize with both the expected duration of a course in weeks or months and the expected commitment per week or per month.

Among those differences between credit-bearing courses and MOOCs, this may be the most navigable; it may be feasible that the credit hour calculation attached to a particular course may be made more continuous. For example, if a 3credit hour course at a particular institution represents three hours of class per week for 15 weeks, it equates to 45 total hours; that number may be translatable to MOOCs' estimates. There may be further modifications necessary; for example, that 45 hours refers to the number of hours of synchronous class time, which certainly is not the only time spent on the class, whereas MOOC time estimates tend to summarize *all* time needed to succeed, not just "class time". However, navigating this conversion may be mathematically plausible.

Where this becomes a greater challenge in MOOCs is with the assumption and assertion of student prerequisites, which carries us to the next difference between for-credit courses and MOOCs.

B. University Admissions

Part of the reason that for-credit courses can operate under this credit hour model is because they have some guarantee of student prerequisite knowledge prior to entering the class. This is initially accomplished through university admissions, ensuring students are prepared for the requirements of the school's curriculum; then, it is handled through chains of prerequisites, where one class can assume students have attained the knowledge associated with a prerequisite class. Ideally this establishes a baseline of knowledge for incoming students which can be used to compute the time required to learn the next course's content.

MOOCs, on the other hand, lack this initial gate; most platforms allow anyone to sign up for a course on any topic and jump in without any assertion that the student is ready for the material. This openness is one of the strengths of MOOCs, allowing students to experiment and explore without preemptively demonstrating readiness or committing significant tuition money prior to starting. However, this openness is also one of the barriers to credit substitutability in MOOCs: aside from a small set of predefined pathways like the College Board's Advanced Placement program, most universities have no mechanism to award credit to nonmatriculated students. Part of admission and matriculation is ensuring the student is ready to earn credit hours in the first place, which connects to being able to accurately gauge the time required to complete a course.

This difference, however, drills down to something more philosophical. Credit hours are typically derived from the amount of time that a course is expected to require to complete, with the optimistic hope that the course content can be adequately covered in that amount of time. If an individual student is able to attain the knowledge in less time, though, do they deserve the same amount of credit? If they require more time, do they deserve more credit? Intuitively we would likely say no; the credit is tied to the content mastery. However, the usage of time as a proxy for course scope presents a challenge especially for MOOCs for which the time required may vary tremendously from student to student due in part to the lack of this initial admissions process.

C. Evaluation

The previous two components interestingly do not heavily touch on what happens within a course; instead, they focus on how the course is defined and how students come to be enrolled. The next three components deal more with what happens within the course. The first is the broad category of assessment evaluation. MOOCs can involve a wide variety of different tasks for students to complete for assessment; the three most common we observe are multiple choice and fill in the blank quizzes (sometimes timed, sometimes proctored), open-ended assignments, and participation on class forums, though some involve larger projects, coding assignments, simulation-based exercises, and more. These assessment strategies largely mirror what happens in for-credit classes as well; what differs is how they are evaluated. For-credit classes often lean heavily on human grading [7]. The massive scale demands of MOOCs, however, force them to rely more on autograding and peer grading; for-credit classes may employ these as well, but rarely exclusively. This reliance often dictates alterations to the assessments themselves as well; while hypothetically a MOOC could require long essays that are sent for peer grading, in practice we see MOOCs more often leaning toward short, autograded quizzes and short, peer graded mini-essays than longer projects.

This examination of assessment and evaluation in MOOCs presents likely the first major obstacle to credit substitutability. As we discussed in the previous section, course credit is tied in large part to content mastery, and course assessments are how that mastery is gauged. Can such mastery be accurately evaluated with peer grading and autograding? Research suggests that in certain contexts [8][9], peer grading can be valid, but those contexts generally are hard to recreate in a MOOC as they require significant commitment and prior knowledge on the part of the peer reviewers. Similarly, autograding may be a reliable way to gauge knowledge in some subjects—such as math, computing, and some sciences, where there are objectively correct answers that can be evaluated by simulation, simple artificial intelligence, or straightforward answer comparison-but in many others robust automated evaluation is still a long way away. Peer and automated grading may still play a support role in for-credit classes, either grading sections of student assignments [7] or supporting human graders [13], but the presence of authentic human evaluation remains a chief differentiating component between for-credit classes and MOOCs, one that we speculate is a significant obstacle to credit substitutability.

D. Academic Integrity

While rarely the most exciting topic to work as educators, ensuring academic integrity remains a significant responsibility in for-credit classes. Among the dominant mechanisms for ensuring academic integrity are proctored (whether in-person or remote) and post hoc plagiarism detection. University cheating cases are significant news items; particularly large-scale misconduct events can be frontpage news when they originate with major universities.

MOOCs are not complete strangers to attempts to assert academic integrity; across their history, MOOCs have experimented with measures like honor codes [1], typing pattern analysis [27], digital proctoring [24], and plagiarism detection [36]. Interestingly, MOOCs also contend with approaches to academic dishonesty that are more structurally prevented in for-credit education; for example, the lack of a formal admissions process and the self-serve account creation

978-1-6654-2486-8/22/\$31.00 ©2022 IEEE 29–30 September 2022, Antigua Guatemala, Guatemala LWMOOCS VIII – Learning with MOOCS 2022 and management approach used on MOOC platforms opens the risk of multiple account cheating, where students use one account to farm answers for use on their real account [31] [34] [35].

That said, while academic integrity is of interest in MOOCs, it does not command nearly the same level of attention. While research has identified ways of using plagiarism detection or multi-account detection to detect cheating, these are rarely used. We argue that this is in large part due to the low stakes of MOOCs: a MOOC certificate does not carry the weight of a credit hour, and so does not spark the same need to defend its reputation. At the same time, though, we argue that this is a causality dilemma: while the comparatively low value of a MOOC certificate justifies devoting little attention to ensuring certificates are earned legitimately, this lack of attention is also a component of why the certificates lack credit substitutability.

E. Support and Interaction

The fifth component we identify that differentiates MOOCs and for-credit classes is the expectation students have for human support and interaction. This aligns in some way with the previous section on evaluation, where students in a for-credit class may generally expect to have their work evaluated by humans rather than peers or autograders, but it extends even to those classes that can reasonably be assessed automatically even in the for-credit space. Students enrolled in for-credit classes generally expect support from instructors or teaching assistants; they answer questions, explain material, and generally support the student experience. Even in asynchronous online classes where course content may be prerecorded, instructors are typically active on course forums or in office hours to provide student support [15].

Some MOOCs include such human support, but many do not; the self-paced nature of many MOOCs allows for more of a set-and-forget model. Many MOOC platforms still allow free enrollees as well, and thus the fund for supporting students may fall far behind the actual amount of student support necessary. On the whole, the level of human support for students in MOOCs is far below that of for-credit courses; given that ongoing human support incurs an ongoing cost, and that MOOCs are significantly less costly than credit-bearing courses, this is generally taken as a reasonable trade-off.

The question remains, though, as to whether that support would be necessary for a course to be substitutable with credit. We find it reasonable to say that authentic assessment and assertions of academic integrity are necessary for a course to be considered credit-worthy; student support, on the other hand, appears to be less about ensuring that passing the course is meaningful and more about increasing the likelihood that students will pass the course in the first place. However, accrediting bodies and legal definitions disagree: the United States Department of Education, for instance, states that distance learning courses must involve "regular and substantive interaction" with faculty; if they lack that, they are considered correspondence courses, which carries with it significant implications. Implicit in this distinction is the idea that a credit-worthy experience is more than ensuring a student fairly passed a number of well-designed assessments; the course experience itself, including the interaction a student has with faculty, is part of that credit-worthiness.

F. Components of Credit Discussion

In exploring the characteristics that differentiate MOOCs from credit-bearing courses, we considered a number of other components as well. A major one is, of course, accreditation: as we referenced in the previous section, various sets of rules-set by accreditors, governments, or architects of standards like Quality Matters [22] or Universal Design for Learning [33]—constrain the decisions that must be made in for-credit courses. Some of these may be applied to MOOCs as well; for example, the US Justice Department ruled that rules set by the Americans with Disabilities Act must be applied to courses hosted at edX.org [1]. Nonetheless, these typically are more heavily applied to credit-bearing courses, especially in the United States at institutions that receive federal funding (which is the large majority of schools) where that funding can be used to ensure compliance with federal rules. However, what we find is that most of these intermediate governing bodies, rules, or standards are largely in service of the five differences we have identified above: they ensure students are fairly supported, reliably assessed, and adequately vetted before credit is assigned. Thus, we argue that-broadly speaking-the existence of accrediting bodies and similar organizations overseeing for-credit offerings is more of a mechanism toward ensuring these five factors are present rather than a separate factor on its own.

Another proposed differentiating factor is the level of oversight present in approving for-credit classes compared to MOOCs. While MOOCs began as extensions of university courses, numerous other organizations have entered the fray, including companies, non-profits, and non-governmental organizations. While university oversight aims to ensure adequate expertise is present to teach a course, that may be absent in other organizations developing MOOCs in service of their own agenda. However, in this comparison, we are largely interested in the minimal gap that may exist between MOOCs and for-credit courses; part of articulating the ways in which MOOCs may be substitutable for credit may involve stating that to be substitutable, a MOOC must be developed by the type of organization that would otherwise offer credit, and subjected to the same oversight that organization might employ.

III. CREDIT CATALOG

With those components identified, we next examine the present landscape of credit substitutability in MOOCs. We treat credit substitutability as a spectrum: on one extreme are MOOCs or MOOC-like courses that are literally already worth credit, while on the other extreme are courses that cannot be seen as credit-worthy in any sense. In between, however, compromises: we will see MOOCs that are suitable for some corollary of credit, such as advanced standing; MOOCs that are substitutable for credit only after being augmented with additional steps; and MOOCs that are not directly substitutable for credit but are argued to command the same level of societal respect as credit due to their adherence to these principles.

Notably, this section does not attempt to catalog every individual initiative; there are far too many efforts to provide students credit for MOOCs and MOOC-like experiences to articulate them all here. Instead, here we attempt to provide a typology for evaluating future efforts toward expanding access to the high-value currency of college credit. We provide this categorization as a way of asking: what is the ultimate currency that a student is earning through these courses, and what steps beyond the MOOC itself are required to attain that currency?

A. Affordable Credit at Scale

Our closest stop to credit on the spectrum of credit substitutability overlaps with the extreme end of the spectrum: courses that are worth credit. This broad initiative has had different names—affordable degrees at scale [32], scalable advanced learning ecosystems [20], large internet-mediated asynchronous/affordable degrees [15], MOOC-based Master's degrees [18][25]—but generally refers to programs that actually do attach course credit to MOOC-like experiences, often in partnership with MOOC providers. This approach began with the creation of Georgia Tech's online MSCS program (a partnership with Udacity) [23] and the University of Illinois's online MBA (a partnership with Coursera) [40], but it has since expanded to dozens of others [32].

Notably, while these programs are offered in partnerships with MOOCs and borrow many MOOC-like features—such as high-quality pre-recorded video in place of synchronous lectures—they also generally supply the five features described above. To earn course credit, students must be admitted to the university. Courses themselves map to the same credit hour scheme as the schools' on-campus programs, ensuring courses are comparably scoped. Human teaching assistants play significant roles in evaluating work [7] and supporting students [15], and significant protections are in place for academic integrity, including robust plagiarism detection [2][12] and digital proctoring [19].

It is important to emphasize that while these programs are inspired by MOOCs and borrow many of the design elements commonly associated with MOOCs, they generally cannot be considered MOOCs themselves: they are not open (university admissions are required), nor massive according to MOOC scale (the largest classes we have identified are around 1500 people per semester [17]). By retaining credit, they must sacrifice some of the defining features of MOOCs.

B. Corollaries to Credit

Inching further away from credit substitutability, our next closest approach is what we call a 'corollary' to credit. Corollaries to credit serve some of the practical functions of credit, but not all. For example, courses may in some places be eligible for conversion into what some schools call 'advanced standing'. Advanced standing assigns to a student credit for having fulfilled some number of credit hours, but does not award actual degree credit or a grade as part of that award; for example, if a degree required 30 credit hours, a student with 6 credit hours of advanced standing may receive the degree by completing only 24 more credit hours. While serving some of the practical functions of a credit hour, it stops just short of actually giving the recipient a letter grade-bearing credit hour that carries weight in their grade point average.

This construct was first popularized long before MOOCs; the International Baccalaureate program and the College Board's Advanced Placement program are two mechanisms whereby college students can earn advanced standing at many universities through completion of massive courses. These sorts of models pioneered some of the ideas that would become common in MOOCs, such as widely distributed curriculum, but also kept the trappings of for-credit courses as well, such as proctored tests and human essay grading.

Among MOOCs on popular Western platforms like edX, Coursera, and FutureLearn, corollaries to credit are rare: the closest we see are in constructs like edX's MicroMaster's or Coursera's MasterTrack certificates, both of which we will discuss in greater detail in the next section. Internationally, however, corollaries to credit models are more common. In India, the central government has constructed the Swayam platform which offers hundreds of courses across a wide range of topics [28]. Like MOOCs, these courses are open to the public and available for free, although obtaining a certificate costs an additional cost to support an in-person proctored exam. Students who complete such a MOOC and subsequently attend a university in India can have the credits earned through Swayam transferred to their academic record. Granted, it remains up to the individual universities to determine how to accept the credit; some do not accept Swayam credits, while others accept them only for specific kinds of credit. There exist universities which accept Swayam for full credit as well, although a comprehensive picture is elusive. China, similarly, sees broader central governmental support for well-respected MOOCs, although to date opportunities to translate those into credit are sparse [36].

C. Paths to Credit

The previous section described instances where MOOCs can be used to fulfill some of the same functional roles as credit, such as reducing the total number of credit hours that must be earned or fulfilling certain prerequisite requirements. Our third relationship between MOOCs and credit is extremely similar, and in fact for some initiatives it may be difficult to identify on which side of the line an initiative falls. The question we ask here is: aside from completing the MOOC itself, how much additional work is required to convert the credential to something substitutable for credit? In the case of corollaries to credit, the work was minimal; it was reasonable to infer that the corollary to credit had been earned, and the question was where it would be applied. Under the category of paths to credit, there is more significant additional work to convert the MOOC certificate into something substitutable for credit.

Among the earliest examples of this model was Arizona State University's Global Freshman Academy [6]. MOOCs in this initiative were open to anyone in the world. Upon completing a course with the necessary grade for some sort of credit substitution, students only then had to pay for the credit. Once the student matriculated to Arizona State University (or other universities accepting the credit), the credit would be transferrable. The key factor here is that the path to counting the MOOC for credit is more involved than we see with corollaries to credit: whereas those credentials were widely transferrable and granted automatically upon completion of the course, the path to credit model requires additional steps, some of which may be particularly significant.

This structure is also the model that underlies edX's MicroMaster's and Coursera's MasterTrack programs. While these programs are modeled after actual university classes and can substitute for them, completion of the MOOC is the first step toward attaining that credit substitution, and some of the later steps are particularly significant. Some such programs involve additional testing or paperwork to convert the credential into its credit substitution. Importantly, most such programs introduce some of the features we described in the previous section; such programs are more likely to require proctored assessments, more likely to have open-ended

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22 IEEE 29–30 September 2022, Antigua Guatemala, Guatemala LWMOOCS VIII – Learning with MOOCS 2022 Page 220 assessments, more likely to apply campus anti-misconduct measures to their MOOCs, and more likely to have paid support for students enrolling in the programs. More than that, though, most require the student to subsequently be accepted and enroll at the institution offering the credential (or another accepting the credential) for it to be substitutable for credit. This distinction with corollaries to credit is subtle, but notable: most MOOCs that follow this path-to-credit model are only accepted at a small number of institutions, meaning the path to receive credit substitution requires enrolling—likely inperson, paying full tuition—at an in-person degree.

There are exceptions, of course. A handful of universities have programs that bridge the gap between these microcredentials with paths to credit and the affordable credit at scale model. For these, subsequent enrollment and receipt of the credit substitution is more trivial than those that require in-person matriculation to the host institution. Part of these path to credit models may also involve leveraging transfer credit mechanisms. Outlier.org, for example, gives students course credit for completing its MOOCs through the University of Pittsburgh-Johnstown which can subsequently be transferred to another institution. Outlier.org is thus an example of a difficult to categorize initiative: in some ways it is more similar to affordable credit at scale in that actual degree credit is given based on completion of the MOOC alone; but in other ways it is more similar to the path to credit model as in order to count that completion for credit at any university besides University of Pittsburgh-Johnstown, a transfer credit process must be employed.

It is worth noting as well that in paths to credit mechanisms, it is often the existence of a path to credit that is used to provide greater implicit endorsement of the credential itself even if it is never substituted for course credit. For example, the first MicroMaster's program was offered by MIT in Supply Chain Engineering; of the thousands of students who enrolled and hundreds who completed, only 40 subsequently joined the on-campus program [25]; but the fact that those 40 students were able to use the MOOC for degree credit substitution serves to provide a stronger endorsement of the credential itself for the others who completed it.

D. Shared Foundations with Credit

This example of the MIT MicroMaster's in Supply Chain Engineering transitions us into the fourth type of relationship we see between MOOCs and credit-bearing classes. In the case of the MIT MicroMaster's, the credential was able to draw from the reputation and recognition of the credit-bearing program by emphasizing that even among students who do *not* use the credential for credit substitution, they still completed the same curriculum as students who did. Under this model, the MOOC in question still shares no formal connection to course credit, but it aims to be somewhat substitutable in the eyes of the public by building on that shared foundation.

Most MicroMaster's, MasterTrack, and similar programs that offer the opportunity for a path to credit operate in some way under this model as well; there is no expectation that all, or even most, of the students enrolling in such a program will complete the full program. Instead, the option to substitute for credit is a way of assuring potential students about the quality and rigor of the program in question. This sort of mechanism dates back to the original MOOCs described earlier, which were modeled directly after a college class but had no pathway to actual convert MOOC completion to credit. Instead, the reputability of the course came from the shared foundations with the credit offering: both the MOOC and the for-credit class covered the same topics covered by the same instructors.

This model remains alive today, and in many ways is even more common because it sidesteps any need for formally connecting to course credit at all. Many schools now offer MOOCs that are built directly from the construction of their in-person class. Likely the most famous is Harvard's CS50 [29], though there are many others. For example, Columbia University offers a program on edX filmed from its in-person class on the Civil War and Reconstruction [5]. Georgia Tech has provided MOOC versions of its first three computer science classes, as well as two math classes, for students seeking to prepare for its online MSCS program [11], and has gone so far as to validate the online version of its CS1 against the in-person version [14][16]. As MOOCs without any formal credit option, these are more likely to continue to leave out the features we identified previously as differentiating MOOCs and for-credit courses, such as robust integrity measures and open-ended assessments. Nonetheless, the MOOC shares some foundation with a credit-bearing course in hopes that in the eyes of admissions committees, potential employers, and anyone else interested in a student's achievement, the MOOC has a stronger reputability.

E. No Correspondence to Credit

Finally, there exists the large category of MOOCs that have no real connection to credit whatsoever. This category covers most MOOCs especially on major Western platforms like edX, Coursera, and FutureLearn. They may carry no connection to credit because their scope and topic is significantly different from anything offered for credit on campus, such as UC-Berkeley's The Science of Happiness MOOC. They may not even be offered by a credit-granting institution as in the case of the many MOOCs now offered by companies and non-profits, such as the many MOOCs offered by the World Health Organization's OpenWHO initiative [38]. There exist mechanisms to try to bring some formality to these environments; Continuing Education Units (CEUs), for example, are similar to credit in that they are meant to be an exchangeable currency summarizing educational attainment, but with far lower barriers to who can award them. Many universities offer CEUs to students who complete their MOOCs; while these are not substitutable for course credit, they play some of the same functional roles.

IV. DISCUSSION

While we have endeavored to create a reasonably objective typology of the different ways courses may relate to credit, there are numerous gray areas between the points on the spectrum. One clear example can be seen in the case of the recent 2U acquisition of MOOC provider edX. 2U is an online program manager that some universities use to offer online for-credit and not-for-credit programs (though generally these programs cost more than their campus counterparts, not less [32]). Although these are not MOOCs, since the acquisition of edX 2U has regularly included these programs in its marketing materials. In one single email from edX recently, we see programs from all five categories represented side-by-side: we see affordable online Master's programs from UT-Austin and the University of Queensland; corollaries to credit in MicroBachelor's programs from NYU and SNHU; paths to credit in MicroMaster's programs from MIT and UC-San Diego; shared foundations with credit in Georgia Tech's professional certificate programs; and offerings with no

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2 IEEE 29–30 September 2022, Antigua Guatemala, Guatemala LWMOOCS VIII – Learning with MOOCS 2022 Page 221 correspondence to credit in GetSmarter's executive education programs. Alongside those as well we see traditional high-cost programs such as online undergraduate degrees and 2U's preexisting professional Master's degrees; on the edX Master's degree page, UT-Austin's \$10,000 Master of Science in Computer Science program is listed side-by-side with Vanderbilt University's \$66,450 program.

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