Micro-Credentials as Evidence for College Readiness

Report of an NSF Workshop

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SCHOOL OF INFORMATION
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Executive Summary

In May, 2017, the University of Michigan School of Information hosted an NSF-funded workshop on the promise and pitfalls of using digital micro-credentials, also known as digital badges, in the college admission process. Micro-credentials are digital artifacts that can be used to recognize, display, and transmit information about an individual student's skills, abilities, and knowledge. Modeled on the physical badges used by organizations such as the Boy/Girl Scouts of America, and websites such as Stack Overflow, micro-credentials offer learners a mechanism for displaying and sharing a wider variety of achievements than grade-point averages or typical transcripts. Digital micro-credentials represent an opportunity for innovating the admission process by providing indicators of college potential that arise from students' experiences both inside and outside of the classroom.

Participants in the workshop included leaders from informal STEM organizations that award micro-credentials, college admissions officers, and experts in the assessment of learning. The goal was to explore and make progress towards answering the following questions:

- Can micro-credentials serve as valid and reliable evidence of prior learning and future potential?
- What "gap" in current admissions practices can be filled by micro-credentials?
- What is required for micro-credentials to be useful for college admission?

In exploring these questions, workshop participants identified a range of issues that require attention in order to make micro-credentials or badges part of the college admissions process. These issues can be thought of as design tensions, in that solving for one issue might pose challenges to others. These issues include:

Equity. In the ongoing work to increase access to and success in higher education, what role can/will digital badges play? Will badges provide new opportunities for learners to represent "non-traditional" accomplishments? Will badges provide less-resourced applicants opportunities to demonstrate accomplishments that are treated favorably by admissions officers and policies? Conversely, might the use of badges stigmatize learners in comparison to those who excel at more traditional measures of college readiness? Will micro-credentials become part of a new "arms race" with well-resourced families becoming more savvy users of badges than under-resourced families?

Validity and Endorsement. If badges are to be useful in the college admissions process, admissions officers need to know that badges represent what they claim to represent. Standardized tests are nationally normed and their validity as evidence of academic potential is verified via conventional measurement principles. In contrast, badges contain evidence, information about how that evidence was obtained, and can contain links to additional evidence and information. As such, their validity as evidence of academic potential is verified according to the perceived credibility of the information they contain. Will admissions officers be able to make these judgements? Will certain valued badges accrue credibility the way that traditional credentials have gained (or lost) credibility over time?

Agency and Authenticity. College admissions officers value authenticity in learners' pre-college activities. Sustained focus and agency are both important (as opposed to a collection of activities meant to enhance one's résumé). How can digital micro-credentials both promote student agency along more authentic paths, and communicate agency and authenticity as part of a learner's college application?

Promoting Lifelong Learning. The moment of college admission can represent a breakpoint in students' curricular and extracurricular engagements. College transcripts, which are a primary way of communicating academic accomplishment to future employers or graduate schools, do not contain information from secondary schools. Digital micro-credentials offer an opportunity to build validated representations of learning that span pre-college and college life, and also lay the foundation for continued engagement post-college. Learning pathways within college might also shift to allow learners to continue to build on their pre-college engagements.

The Need for Infrastructure. For digital micro-credentials to be useful, a technical infrastructure needs to be built with a focus on privacy control and data protection, openness, and interoperability. The IMS Global Learning Consortium, the leading organization in setting educational technology standards, is currently working with educational institutions and private-sector partners on this challenge. The recent merger of the two leading commercial badging platforms suggests that badges will endure as the primary manifestation of digital microcredentials. Over-consolidation may present risks, and moving forward it is important to avoid over-reliance on either a single platform or commercial providers and to preserve open access.

Scalability. Finally, any successful use of badges in college admission requires systems that support the processing of micro-credentials at large scale. College admissions officers felt that badges had the potential to be an important part of a holistic review process, but only if issues revolving around equity, validity, and authenticity can be resolved in a way that enables badges to be integrated into an already-challenging admissions workflow.

Workshop participants concluded that there is great potential for digital micro-credentials in the higher education admissions process, assuming that the issues raised in the workshop can be adequately addressed. Digital badge portfolios could be data-mined in order to facilitate better matching between students and institutions, helping to remediate current challenges such as under-matching, where learners do not apply to highly competitive schools under a mistaken assumption that they are not qualified for admission. As the numbers of applicants to colleges increase, it is important that micro-credentials add critical and persuasive information without creating either bottlenecks in the review process or new inequities. To address this challenge, an ecosystem for validation and endorsement of micro-credentials needs to be developed.

Finally, we must recognize that in addressing the issues outlined above and moving towards the use of digital micro-credentials or badges in support of the college application process, the greatest benefits to society will likely be accrued by working towards broader changes in how we organize learning and recognize learners and their accomplishments both within and beyond the current formal education system.

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Table of Contents

- 1.0 Introduction
- 2.0 Overview of Workshop
- 3.0 What are Micro-Credentials?
- 4.0 Institutional Perspectives on College Admissions and Micro-Credentials
- 5.0 Case Studies of Micro-Credential Issuers and Earners
- 6.0 Design Thinking and Issue Generation to Advance Micro-Credentials in Admissions
- 7.0 Observations and Recommendations
- 8.0 Conclusion
- 9.0 References

Appendices

A. Workshop Agenda
B. Workshop Participants
C. Design Group Charge

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1.0 Introduction

Higher education is in a bind when it comes to the challenge of expanding opportunities and access. Colleges and universities seek to establish rigorous and fair criteria for admission, while simultaneously increasing the diversity of their student populations. Higher education, at all levels, has trouble identifying qualified students, trouble admitting underrepresented students due to legal challenges to affirmative action (e.g., Barnes, 2014), and trouble recruiting qualified students who do not see a space for themselves in post-secondary education (Hoxby & Turner, 2015). The most widely-used admissions indicators – standardized tests – are highly correlated with socioeconomic status (Freedle, 2003; Blau, Moller, & Jones, 2004) and fail to measure the kinds of capabilities characterized as "21st Century skills" such as critical thinking and problem solving (Braun & Mislevy, 2004; National Research Council, 2012), making them poor indicators of post-secondary success for the very students colleges actively seek. Meanwhile, learners increasingly participate in meaningful activities outside the context of formal education that do provide opportunities for leadership and learning of the sort colleges desire, but without a clear — or readily scalable way — to document learning in these contexts. Thus the bind.

What is needed are valid and reliable indicators of college potential that arise from students' experiences both inside and outside of the classroom, in a format that colleges can readily include in their admissions decision-making. A growing number of selective liberal arts colleges have begun to experiment with "test optional" approaches to admission (FairTest: The National Center for Fair and Open Testing, 2015). Schools that are making standardized test scores optional employ a range of alternatives for gauging suitability for admission, most commonly high school GPA and essays. Early evaluations about test-optional approaches raised concerns that they might not increase access and diversity (Belasco, Rosinger, & Hearn, 2014), as they continue to rely on traditional academic indicators that often prove challenging to non-dominant student populations (Gutiérrez & Rogoff, 2003). More recent data indicates that when such programs are implemented well, they can lead to increases in underrepresented students in both the applicant pool and first-year class (Syverson, Franks, & Hiss, 2018). A consortium of elite independent schools is experimenting with a "mastery transcript" approach to documenting learning that would replace traditional GPA and course-based transcripts (http://www.mastery.org/) with a "whole student" view of accomplishment and potential based not on grades, but on demonstrated mastery of various skills, knowledge, and habits of mind.

Micro-credentials, or digital "badges," are likely to play an increasingly prominent role in this conversation, but as of yet they have not been widely tested or deeply examined. As a way to represent student learning, micro-credentials can be used to demarcate learner accomplishment more holistically and increase opportunities for students to gain expertise through learning experiences that span various contexts (National Science Board, 2010). But how reliable are micro-credentials as indicators of student learning? How should micro-credentials be interpreted as indicators of academic potential?

What is needed are valid and reliable indicators of college potential that arise from students' experiences both inside and outside of the classroom.

This report presents findings from a two-day workshop on micro-credentials in college admissions held in May, 2017. The workshop was attended by leaders from informal STEM education organizations, college admissions officers, and experts in the assessment of learning. The intent was to bring together people who represent different aspects of the college admissions process, but who do not normally interact. The opportunity to hear directly from college admissions officers, for example, was eye-opening to informal STEM education providers. Participants collectively explored the potential of using micro-credentials as alternative indicators of college readiness, and micro-credentials' potential to promote equity and inclusion in post-secondary education. Participants learned about the state of micro-credentials, the challenges faced by college and university admissions departments, and explored case studies from two micro-credential producers. Following this, participants collaboratively defined approaches that would enable micro-credentials to be a valid and valuable part of the college admission process. In so doing, a range of critical issues that require further attention were generated. These issues can inform the evolving research agenda around micro-credentials in the college admission process.

Initial findings from the workshop were shared with participants at the 2017 Badge Summit gathering held prior to the meeting of the International Society for Technology in Education (ISTE) in San Antonio. Feedback from attendees at the Badge Summit confirmed the findings of the workshop, and their overall congruence with the direction of the larger micro-credential community.

How should micro-credentials be interpreted as indicators of academic potential?

This report highlights key design and policy issues and makes recommendations for future research needed at the intersection of micro-credentials and college and university admissions.

2.0 Overview of Workshop

The workshop described in this report was held on May 16 and 17, 2017, at the University of Michigan School of Information in Ann Arbor, Michigan. Our goal was to address opportunities for using digital micro-credentials as evidence for college readiness, as part of the college admission process. In a report from a 2013 workshop (DRL-1265478), Riconscente, Kamarainen, & Honey (2013) provided a simple definition of micro-credentials or digital badges: "a digital badge represents a judgment by an organization or individual regarding a person's experiences, abilities, knowledge, or qualifications" (p.1). That report concluded that the success of the badge movement would be based on a clear distinction between assessments (criteria-based evidence used to make claims about learning; Messick, 1994; Mislevy, 1994) and credentials (the judgment of an organization or individual regarding a person's experiences, abilities, knowledge, or qualifications), placing badges in the latter category despite acknowledging that they "have the potential to bring a new kind of transparency and personalization to assessment and consequently to credentialing processes" (Riconscente, Kamarainen, & Honey, 2013, p. 4). This kind of conceptual confusion about digital badges has resulted in a disconnect between the world of assessment and the potential for micro-credentials – as badges or in other forms – to serve as useful components of alternative pathways into higher education. To address this confusion and investigate the role of micro-credentials as indicators of students' potential, the current workshop convened a diverse group of researchers and practitioners who each have a stake in the issue of access to higher education.
The workshop addressed the following questions:

- Can micro-credentials serve as valid and reliable evidence of prior learning and future potential?
- What "gap" in current admissions practices can be filled by micro-credentials?
- What is required for micro-credentials to be useful for college admission?

The workshop was designed to foster conversations and potential research collaborations among assessment researchers, learning scientists, and system designers, informed by participation of micro-credential "consumers" (e.g., admissions officers, university faculty) to develop an informed vision of micro-credentialing, and to provide guidance for the further conceptualization, validation, and implementation of alternative pathways into higher education.

3.0 What are Micro-Credentials?

In the wake of a growing accountability movement in education (e.g., the Spellings Commission Report, U.S. Department of Education, 2006), higher education has moved towards developing systems that provide a means of demonstrating learning objectives, performance criteria, and ultimately learning outcomes. However, these efforts have focused primarily on the capacity to compare student outcomes across higher education institutions rather than as a means for recognizing and supporting individual student trajectories. Micro-credentials, as digital artifacts, represent a flexible and portable format for recognizing, displaying, and transmitting an individual student's skills, abilities, and knowledge that are awarded through the judgment of a designated entity or authority (Riconscente, Kamarainen, & Honey, 2013). Modeled on the physical badges used by organizations such as the Boy/Girl Scouts of America, and combined with the virtual achievement badges used in video games and on websites such as Stack Overflow, micro-credentials offer learners a mechanism for displaying and sharing a wide variety of achievements.

Digital micro-credentials represent an opportunity for the credentialing world — dominated by transcripts and degrees and regulated by registrars and others who assure the validity of information about student learning or preparation — to embrace the possibilities of the rapidly evolving digital world. These new credentials are currently represented in the form of digital "badges." As a digital record of achievement, micro-credentials allow the storage, transfer, and evaluation of multiple indicators of learning (Hickey & Willis, 2017). Where GPAs and test scores offer little in the way of context and transparency, a micro-credential provides instructors, students, and also admissions committees with a context-rich representation of student achievement that is compact and portable, yet simultaneously much richer and more evidence-based than current representations such as transcripts. By providing detailed evidence of learning accomplishments

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to students, micro-credentials can play a vital role in motivating students toward the development of "21st Century skills" that are otherwise hard to measure in formal education. Capability in areas described by 21st Century skills, such as the ability to communicate clearly or to collaborate with others, are thought to predict success in postsecondary education (National Research Council, 2012). The difficulty in capturing such capabilities with standard measurements of academic achievement emphasizes the potential advantage of micro-credentials over GPAs and test scores.

Micro-credentials are not in themselves assessments, but rather indicators of achievement or learning that have been assessed using some other means (Riconscente, Kamarainen, & Honey, 2013). Admissions officers using micro-credentials would therefore need to examine and assess college readiness from a detailed understanding of the evidence contained within any micro-credential; what it represents and the credibility of its source. This is particularly challenging given the diverse landscape of micro-credential issuers as well as the diverse types of micro-credentials and learning they represent; i.e., recognizing learning, assessing learning, motivating learning, studying learning, and discovering learning. This challenge must, however, be addressed as learners from all backgrounds are turning more frequently to open, online, and informal learning to supplement their education or advance their careers, increasing the likelihood that students will submit evidence of their success in these activities — often including micro-credentials — as evidence of preparation and learning (Hickey, 2017).

In 2011, the Mozilla Foundation led the development of the Open Badges Initiative (OBI), an open source framework for issuing, collecting, and displaying digital badges (http://openbadges.org). Technological advances, growing adoption of game environments and mechanics (e.g., Shute & Ventura, 2013), and an increasing interest in recognizing co-curricular learning have spurred the adoption of digital badges in educational contexts (Young, 2012). The ecosystem of OBI-compliant digital badges is aimed at serving issuers, earners, and employers (Goligoski, 2012) by creating a common infrastructure for issuing, organizing, and sharing micro-credentials. First, a badge issuer, such as a co-curricular organization or an individual faculty member, decides what criteria learners must meet in order to be awarded a specific badge. Learners then apply for recognition and, once awarded, collect relevant badges representing their accumulated accomplishments. Badges can also be offered in sequences, allowing students to "level-up" as they demonstrate mastery in a given domain (e.g., move from novice to expert). Using Mozilla's digital "backpack", the micro-credential "earner" can display their badges on social networking websites, blogs, electronic portfolios and, potentially, in an online application to a college or university. Organizations have long experimented with portfolios as a way to support student agency and self-representation, and in our workshop, it was generally accepted that portfolios and digital badges go hand-in-hand with respect to the college admissions process. Increasingly diverse types of organizations are issuing open badges, including community organizations, museums and libraries (http://openbadges.org/participating-issuers/). Digital Promise, for example, is developing an educator-focused ecosystem of micro-credentials using the Open Badge standard (see http://www.digitalpromise.org/). IMS Global is currently managing the oversight of the standard to "further the adoption, integration and transferability of digital credentials, including badges, within institutions, schools, and corporations" (see http://www.imsglobal.org/pressreleases/pr150421.html).

Rising interest in micro-credentials is consistent with a number of current movements in education, either enabled by or involving digital technologies. Micro-credentials are most often used to denote student activity in co-curricular learning, apart from the formal demands of traditional classroom learning. The University of Michigan, for example, has been examining how digital badges can help structure and incentivize student participation in programs designed for "at-risk" groups in STEM education (http://www.mblem.umich.edu/). There is also a growing recognition of the importance of co-curricular and "life-wide" learning, extending far beyond traditional classroom time (Banks et al., 2006). Learning across contexts is also a cornerstone of the Connected Learning movement, which advocates for "learning that is socially embedded, interest-driven, and oriented toward educational, economic, or political opportunity" (Ito et al., 2013, p. 4). A key to connected learning is building bridges across contexts - academic, social and civic - in which youth meaningfully engage in activities that contribute to their learning and development. Many of the enterprises in the connected learning movement employ digital badges. Dan

Hickey and colleagues at Indiana University conducted foundational research into the range of ways such micro-credentials were used. The groups they studied were using micro-credentials for motivating learning (Schenke, Tran, & Hickey, 2013), recognizing learning (Rehak & Hickey, 2013), and assessing learning (Itow & Hickey, 2013). Hickey and colleagues' work enumerates key design principles for all three of these ways of looking at badges.

In higher education, there are a growing number of examples of digital badges being employed to recognize both curricular and co-curricular activities. For example, within the sustainable agriculture program at the University of California-Davis, students display mastery of core competencies (e.g., systems thinking), including relevant learning outcomes and skill sets, in order to successfully complete the major (Fain, 2014). Seton Hall University has developed "Pirate Patches" to encourage and recognize students' co-curricular experiences (http://tltc.shu.edu/badges).[1] Pilot efforts experimenting with implementing digital badges into courses have generally yielded positive responses from students (e.g., Hakulinen, Auvinen, & Korhonen, 2013; Santos, Charleer, Parra, Klerkx, Duval, & Verbert, 2013). Ahn, Pellicone & Butler (2014) note that there are inherent conflicts at play between differing conceptions of badges, but the potential is high. "If badges continue in use across educational contexts, there could be rich opportunities to examine the processes through which badges become used and appropriated in ways that begin to resemble more established credentials such as degrees" (Ahn, Pellicone, & Butler, 2014, p. 4).

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Digital representations of learning experiences can be supported by rich metadata stored within micro-credentials, including information such as the issuer, description, criteria, and submitted evidence. This metadata allows badge "consumers" (e.g., admissions officers, faculty, future employers) to view and evaluate both the judgment about and evidence for each accomplishment, thus increasing the transparency of assessment processes beyond current systems (Riconscente, Kamarainen, & Honey, 2013). The MacArthur Foundation, a strong early promoter of experimentation in micro-credentials, wrote on their web site that digital badges "make visible and validate learning in both formal and informal settings, and hold the potential to help transform where and how learning is valued" (MacArthur Foundation, n.d.). However, a major impediment for advancing the use of micro-credentials lies in the different conceptions about the basis for awarding badges. In particular, the distinction between awarding badges for "participation" versus "skill-based" outcomes has created a divide between micro-credential issuers and potential consumers. The answer is not to dismiss participation badges, which can be used to provide motivation and guidance for students to identify future learning opportunities (Davis & Singh, 2015), but rather to support organizations in developing valid and reliable assessment practices that can be employed to issue micro-credentials certifying accomplishment.

Developing an infrastructure to enable the creation and use of reliable assessments by a wide range of potential badge issuers presents a significant challenge to using micro-credentials in college and university admissions. In a special report of the Chronicle of Higher Education, Hickey (2017) recognized recent advancements in micro-credentialing which could provide significant affordances to their practical integration into the admissions infrastructure. For example, the release of the Open Badge 2.0 specification in December 2016 (https://www.imsglobal.org/sites/default/files/Badges/OBv2p0/index.html) included provisions for the inclusion of verified third-party endorsements. The concept of third-party badge endorsement is key, as this can reduce the burden on college admissions officers to re-assess the meaning of any particular micro-credential as part of an admissions portfolio. An important takeaway of the current workshop is that third-party endorsement will likely play a prominent role in establishing trust and scalability in micro-credentials. Additionally, the IMS Global Learning Consortium recently established standards for micro-credentials to be integrated into learning management systems, potentially helping accelerate their use in formal learning contexts (https://www.imsglobal.org/activity/digital-credentials-and-badges). This is the organization that developed the widely-adopted Learning Technology Interoperability standards (LTI), which bodes well for their involvement in further developing standards for micro-credentials. Further, members of the IMS executive board for Digital Credentials represent a variety of important stakeholders including academia, industry and foundations (http://www.imsglobal.org/leadership/digital-credentials-executive-board).

Hickey (2017) recognized that with the new Open Badge 2.0 specification, micro-credential earners, producers, and consumers are better able to communicate with one another and share information through multiple portfolio platforms. The need for micro-credential standards is

[1] Many micro-credential efforts employ "playful" language or framing, which might impede their being accepted as a "serious" component of the student credentialing process.

a global concern. Hickey also noted that the Bologna Open Recognition Declaration, signed by members of an international consortium of authoritative experts and scholars, recognized the value of micro-credentials in promoting student agency and control over their learning. These recent initiatives demonstrate an increased understanding and recognition of micro-credentials' potential value by stakeholders worldwide. Maintaining interoperability among emerging micro-credential systems will remain important both for increasing learner choice and agency, and lowering the start-up costs for new organizations looking to start using micro-credentials.

4.0 Institutional Perspectives on College Admissions and Micro-Credentials

A key design feature of the workshop described in this report was the inclusion of enrollment management (EM) and college admissions officers representing different institutional perspectives. This included senior EM and admissions officers from the University of Michigan (UM), representing a large and highly-selective public institution that processes many tens of thousands of first-year college applications each year. It also included the chief admissions officer for Kalamazoo College (K-College), a highly-ranked small, private institution that reviews many fewer applications, but which exists in a different type of competitive environment from Michigan. The workshop also included representatives from the Penny Stamps School of Art and Design (Stamps), a small school within the larger UM that conducts a parallel first-year application process. Admission to Stamps is based heavily on students' self-constructed portfolios, a process that is more analogous to using digital micro-credentials than many current undergraduate admissions processes. And finally, we were joined by representatives of the Parsons School of Design and the Stevens Institute of Technology, two New York City-area institutions that are attempting to work directly with one of the case study presenters at the workshop (more on this below).

In the language of micro-credentials, college admissions officers are "consumers," who need to make sense of the information provided to them by learners who earn badges.

By including college admissions officers, workshop participants were able to hear directly from those who would need to utilize micro-credentials about the practices and challenges of their work, along with hearing updates about current innovations in college admissions.

In the language of micro-credentials, college admissions officers are "consumers," who need to make sense of the information provided to them by learners who earn badges. To date, much work in digital micro-credentials has focused on their use *within* post-secondary education, or for creating a path *from* college to the workforce. To our knowledge, this workshop is one of the first to directly address the question of broadening access *to* college with micro-credentials. A forthcoming paper (Pitt, Strickman, & Davis, in press) from an NSF-funded research project led by Katie Davis at the University of Washington reports on interviews about perceptions of digital badges with 19 college admissions officers from a range of institutions in Washington State. The findings reported by Pitt, et al., are consistent with the findings in this report, as noted below.

College and university admissions involves, simplistically speaking, two groups of people: applicants, which includes both students and their guardians and influencers, and the institutions of higher education which review and admit applicants. This can of course be further refined to differentiate institutions by public and private, size, geographic location, religious affiliation, mission, endowment, and so forth. Students and guardians/influencers can similarly be distinguished by a broad range of socio-economic, geographic, religious, ethnic, and cultural diversity.

What remains true regardless of the composition of either group is the challenge of communicating about the college admissions decision-making process with the public and recruiting promising students in an ever changing social, economic, and political landscape. To most learners, parents, and organizations involved in supporting K-12 learning, the college admissions process is opaque. Any changes made to increase access can result in rapidly increasing numbers of college applications - such as happened with the introduction of the Common Application - leading to increased competition without necessarily increasing equity. Navigating the space between these challenges is critical for all institutions of higher education, as their ability to successfully recruit, admit, and enroll students directly affects the desired characteristics of the institution (Rigol, 2003).

4.1 Admissions Processes at Institutions of Varying Scope

What follows is an account of the cultural and decision-making processes at play at the three different types of institutions represented at the workshop. The collective knowledge gained from these accounts can shed light on the affordances and limitations of using micro-credentials in college and university admissions generally, although specifics may differ at other types of schools or at particular higher-education institutions.

4.1.1 University of Michigan (Large Public)

For its 2016 freshman class, the University of Michigan at Ann Arbor (UM) received 55,504 applications, granted admission to 15,871 applicants, and enrolled 6,689 students, with the largest number enrolling in the College of Literature Science and the Arts (LSA) and the College of Engineering (CoE). UM has 19 different schools and colleges, seven of which admit first-year students directly (see Stamps, below), but all are dwarfed by the scale of LSA and CoE. A large and prestigious public research university, UM faces unique challenges formulating a freshman class from a massive pool of applicants that increases year-by-year and draws from all 50 states and 122 nations (the most recently admitted class is profiled at https://admissions.umich.edu/apply/freshmen-applicants/student-profile).

The average applicant from this pool had a 3.87 GPA on a 4 point scale and standardized test scores that were similarly competitive. Speaking in terms of academic achievement broadly, there is not much variation in the type of student that applied to UM in 2016. Most applicants have high test scores, high GPAs, and experience in Advanced Placement, International Baccalaureate, and other advanced classes in their high school. Thus admissions decisions based solely on academic preparation would be impractical and difficult. Moreover, because high academic achievement correlates with socioeconomic status, relying solely on academic preparation does not align with the institution's mission to encourage "important learning and democracy" outcomes through interactions among members of a student body that is representative of the diverse backgrounds and beliefs of society (Gurin, Dey, Hurtado, & Gurin, 2002). As a public institution, the UM admissions process, though not directly accountable to the Michigan legislature, is subject to statewide ballot initiatives such as one passed in 2006 banning the use of affirmative action or racial preferences in college admission. Prior to that, a 2003 U.S. Supreme Court ruling shaped the way that UM gathers and reviews student admission information. Furthermore, as a public institution, UM is subject to Freedom of Information Act requests with respect to its admissions process. These conditions create a environment for accountability around college admissions at UM, leading to a broad range of approaches and experiments related to increasing the diversity of the student body along multiple dimensions.

To help the UM meet its diversity objectives, the admissions office employs a holistic review process that looks beyond standardized test scores and GPAs. Applicants are asked to submit additional information regarding their academic and extracurricular achievements, and write multiple essays to encourage the development of context so a holistic review of a student's accomplishments and potential contribution to the university can be understood by reviewers.

To help ensure that UM gives each application a fair and thorough holistic review, the admissions office employs multiple application readers: a blind review in the admissions department, a blind review by a regionally assigned reviewer, and a final senior-level reader internal to the admissions department. If additional understanding or interpretation is required, UM may reach out to high schools and seek input from community stakeholders. Similarly, applicants may also be reviewed by faculty/staff admission committees within the colleges and schools. Given the scale of the admissions operation, student interviews are not possible. In the end, it is important for both UM and the student to understand how each student would contribute to the diversity of ideas and opinions expressed on campus.

The UM has recently developed "pipeline" programs designed to broaden awareness of and preparation for the university in communities that are not currently well-represented among UM's applicant pool, including urban and rural communities. For example, Wolverine Pathways (https://wolverinepathways.umich.edu/) is a program that begins working with students in middle school, and upon successful sustained engagement with the program through high school, students are offered support for application to UM and full tuition if admitted. Members of the Wolverine Pathways team attended the workshop, with interest in employing micro-credentials as part of the program.

A fundamental commitment of admissions officers at the workshop is that admitted students are prepared to succeed.

A fundamental commitment of admissions officers at the workshop is that admitted students are prepared to succeed. To help increase the diversity of the admitted class, potential for success is viewed through a range of lenses, and the UM provides several different types of student success programs for learners who may not have had optimal opportunities or support in high school. All admissions officers present at the workshop were clear that no one's interest is served by admitting a student who does not have the preparation to succeed at that institution.

4.1.2 Kalamazoo College (Small Private)

Kalamazoo College (K College) is a highly-ranked small, private, liberal arts college of 1,400 students in southwest Michigan with an applicant pool that draws heavily from Michigan and nearby states. The applicant review board, comprised of twelve people, uses a 50 point scale —set by

faculty—to determine an applicant's potential to succeed and contribute to the campus community. All files are reviewed by admissions staff and a small number of borderline applicants are reviewed further by faculty. The average applicant from this pool in 2016 had a 3.8 GPA on a 4 point scale and almost half of admitted students are in the top 10% of their high school class rank. The college became a "test optional" school in 2016, joining more than 800 colleges and universities in the country to admit students without regard to ACT or SAT test scores. K College has an emphasis on diversity in their recruiting goals; current students come from 43 states and 32 countries, and 27.9% are domestic students of color (http://www.kzoo.edu/student-life/diversity/).

The primary factor affecting K College's ability to recruit an incoming class is competition from large regional public institutions, including the UM. This is the result of changing demographics: the shrinking number of high school graduates in its regional applicant pool, the impact of economic hardship on families in the midwest, and the changing racial makeup of the United States.

K College is distinct from public institutions in the state of Michigan because it can take racial and gender composition into consideration when formulating its freshman class. K College grants admission to roughly 70 percent of its applicants, a number it believes to be fairly typical of similar institutions. After conducting four years of research, K College determined there was no correlation between test scores and how their students perform after matriculating. As a result, K College adopted a "test optional" admissions process and removed the application fee for all applicants, making it easier for students to apply through the Common Application, an online college application portal that allows students to submit a relatively uniform application to as many as 20 institutions (also used by UM). A growing number of colleges are adopting a "test optional" approach to admissions (see http://www.fairtest.org/), but in place of SAT or ACT scores, students must present alternative materials to help colleges understand their academic qualifications and potential. The result is a holistic review process similar to the one employed by UM, but with fewer standardized measures that can be used to describe the academic variation within the admitted class and greater leeway to admit students who increase the diversity of the incoming class. Micro-credentials represent an opportunity to help an institution like K College make sense of non-standardized measures of student preparation or accomplishment at scale.

4.1.3 Penny W. Stamps School of Art and Design (Small School/Portfolio Driven)

The Penny W. Stamps School of Art and Design (Stamps) is a small school within the UM that admits students directly as first-years, meaning that they conduct their own admissions review independent of the larger UM context. As a school of art and design, Stamps requires students to submit a portfolio of 12 to 15 pieces of original creative work to demonstrate their artistic and design ability. This portfolio accounts for 50 percent of the admissions decision. While portfolios are different than micro-credentials, they both provide an analogue and are likely to be a critical part of any admissions process employing micro-credentials. The "backpack" of the original Mozilla badge specification is itself a kind of portfolio, where learners assemble collections of credentials in order to present themselves to particular audiences. The portfolio-driven admissions process at Stamps thus presents hints of what a future micro-credential-driven process might be like.

Applications to Stamps are first processed and reviewed by the UM undergraduate admissions office, in part because Stamps students take general education coursework in the broader UM community (including within the two largest schools: Literature, Science and the Arts and the College of Engineering) and therefore must present academic qualifications affirming their potential for success. Students then submit their portfolios directly to Stamps for review using Slideroom, a commercially-available online tool for reviewing portfolios and other applications that also has interoperability with the Common Application.[2] Creative work can consist of photography as well as photos of drawings, sculptures, and other work—two of which must be design or direct observation drawings. Stamps takes the breadth of the student's work as well as the extent of their experimentation with media into consideration.

One of the challenges with the use of these portfolios is that many students with the potential to be successful at Stamps have never assembled a portfolio before. This is particularly important given that how work is presented may have an influence on how that work is perceived. This is a diversity and equity issue. Students in secondary schools with strong art programs may have support for everything from conceptualizing portfolio contents to actually lighting and photographing the artworks. To address this issue, Stamps created a video tutorial to guide students through the curation process.[3] In the video, Stamps staff emphasize that artwork can be captured with simple tools like smartphone cameras, and that they are looking at the work more than the presentation.

For each piece of work submitted, Stamps requires students to answer the question, "Why did I create this?" This aids Stamps in their holistic evaluation of the application and potentially provides insight into the resources available to students through their high school and community.

[2] For more information on Slideroom see http://www.slideroom.com/index.html

[3] To view the Stamps "Preparing Your Portfolio" video tutorial and gain more information about Stamps' review process, see http://stamps.umich.edu/undergraduate-admissions/portfolio

This is significant because ultimately Stamps must make a determination of whether a student will be successful in both their studio-driven curriculum and in general education coursework. While a student's creative potential contributes to the possibility they will thrive in this environment, it cannot be the sole determining factor. This is another area where digital badges that represent student engagement and potential beyond the standard academic transcript could add value to the process and allow for students from communities without strong arts education in the schools to stand out.

4.2 Similarities and differences among admissions approaches

The admissions representatives from Stamps recognized the potential of micro-credentials to supplement the portfolio, believing that micro-credentials indicating skills with particular artistic media or contextual information about student learning or persistence can provide crucial information to make holistic admissions decisions. But would micro-credentials be integrated with the current admissions review process, or become an additional step? Adding time to the admissions process is not attractive for admissions officers, given their already challenging (and growing) workload. This sentiment was shared by all admissions representatives at the workshop, emphasizing the small window of time available to assess each individual amidst a large volume of applications. Consequently, for micro-credentials to be considered in the admissions process, they would need to be introduced as either a time-saving or time-neutral component.

The notion of a "holistic review" that goes beyond standardized measures and GPAs was common across all admissions officers at the workshop, but the means and methods of conducting a holistic review varied. Much like UM, K College considers extracurriculars, personal essays, academics, and letters of recommendation in its application process. Additionally, both institutions consider a student's demonstrated interest in the institution; academic achievement, academic quality and potential; educational environment; and character. Moreover, faculty are involved in the evaluation process at both institutions but at different stages and for different reasons. Typically, faculty are consulted when a determination of an application component cannot be easily evaluated by the application readers on staff in the admission office.

All admissions officers reported feeling pressure to be thorough and meticulous in their work, and to rely heavily on uniformity of information (or at least of the information requested) to enable them to make fair determinations. It is often not possible — currently — to review "special" materials unless the shape and format of those materials are specified by the admissions process, such as with portfolios at Stamps. A primary constraint for UM is the shear volume of applications. This is still a challenge despite employing more than 100 application readers. While K College receives far fewer applications, it still must holistically review thousands of applications with only twelve readers, and often without the benefit of standardized test scores. These are all steep challenges in the work of admissions officers.

4.3 How Admissions Officers view Micro-Credentials

The admissions officers at the workshop were skeptical of alternative credentials, since it is not yet understood how they would fit into a system that depends heavily upon uniformity for efficiency and possibly equity. They did, however, recognize that students will begin to include micro-credentials as soon as selective universities start to accept them. Where and how they would be included in the application is unclear, as is the consideration micro-credentials would or should receive in the review process.

Stamps' use of portfolios and the growing interoperability of micro-credentials and portfolio systems demonstrates the potential for integrating micro-credentials into college and university admissions. However, Stamps admissions officers are professionals specifically trained to review art portfolios, and therefore generally know what they are looking for when they view an applicant's artistic output. What kind of professional development would be required to train college admissions officers to look at badges and make comparative judgments about quality or potential for success? What would it take for badges to become as "easy" to interpret as a standardized test score, and is this even possible?

How will college admissions officers interpret badges that come from varied and unfamiliar issuers?

Many successful badge programs rely on intimate knowledge of both what the badges represent and the context(s) in which they were earned (more on this below). How will college admissions officers interpret badges that come from varied and unfamiliar issuers? Currently, admissions officers are able to develop a comparative sense of what a GPA (for example) means across different types of secondary schools. What kind of validation processes is needed to help admissions officers interpret learning (or other outcomes) represented in badges from different issuers? A better understanding of the learning outcomes that communicate college readiness and the fidelity of micro-credential validity is crucial to the successful use of badges.

The consideration of micro-credentials in college admissions as a vehicle for democratizing access to higher education will be moot if micro-credential use replicates the known problems of traditional measures.

UM undergraduate admissions officers also noted that while being ranked highly in one's class adds considerable value to an application, such a student may still not be academically prepared for rigorous UM academics if they come from an under-resourced secondary school. This raises the question of UM's mission and responsibility to serve different communities. Considerations should be made for the affordances and limitations of a micro-credential system to align formal and informal learning outcomes, connect communities, and the potential of these partnerships to create pathways into post-secondary education. Stamps faces this challenge by reaching out to under-resourced communities to help them develop an understanding of the importance of arts education and supporting the development of young artists. Access to and participation in informal learning will not increase pathways into post-secondary education if they are not utilized. Ultimately, the consideration of micro-credentials in college admissions as a vehicle for democratizing access to higher education will be moot if micro-credential use replicates the known problems of traditional measures. Specifically, a common fear expressed by all workshop attendees was that the badges could simply add a new component to "the arms race" character of current college admissions processes.

5.0 Case Studies of Micro-Credential Issuers and Earners

To illuminate and illustrate well-developed uses of micro-credentials, we invited two different organizations to share cases of learners and learning with digital badges at the workshop. *The Chicago City of Learning* and *Mouse* are non-profit organizations with a well-developed range of programs aimed at diversifying youth agency and learning. These organizations represent examples of badge "issuers," and the youth who participate in their programs are badge "earners." In addition, both organizations have begun the work of designing and systematically deploying badges with the intention of expanding opportunities for learners, including opportunities in higher education. These organizations have explored a range of different mechanisms for using badges, including providing portals to identify learning opportunities, and platforms for learners to organize, display, and share digital badges.

5.1 Chicago City of Learning

In 2011, the MacArthur Foundation, Mozilla, and the Digital Youth Network partnered to form the Chicago City of Learning (CCoL), a "Connected Learning infrastructure that helps break down the barriers between the learning that takes place across spaces" (Chicago City of Learning, 2016, pp. 2-3). The work of CCoL served as an example of a way to promote learning agency by making connections across various domains of a learner's life, leading to the development of a broader Connected Learning Framework (Ito et al., 2013), which describes a growing number of aligned efforts.

The Digital Youth Network, which was both the predecessor and the parent organization of CCoL, articulated a standardized micro-credential framework that could be used by both formal and informal learning providers throughout the city. Working in concert with the City of Chicago Mayor's Office, CCoL helped to organize, promote, and document learning across the city. Participating providers were able to use micro-credentials provided by CCoL to document the learning occurring through their programs. Because the micro-credentials have uniform standards, they integrate with CCoL's online portal. This both allows students to identify new activities based on prior engagements and to document their achievements in one unified space.

Another advantage of CCoLs unified data framework is that it can be used to examine patterns of participation, to examine the popularity and usage of different programming, and to visualize equity (or inequity) of access to programming. Using digital mapping techniques, CCoL can visualize the prevalence (or scarcity) of learning opportunities, informing program and policy development. This has so far resulted in the implementation of mobile maker labs which bring learning opportunities to those neighborhoods with significant need (Chicago City of Learning, 2016). For instance, if opportunities for learning to code are clustered around the city core, learners from the city's far south side may have to travel for hours by bus or train to participate. This could have the effect of depressing engagement for learners from less-resourced neighborhoods. It could also indicate that learners from those neighborhoods who do participate are demonstrating a higher level of "grit" or motivation than learners for whom the activity is more conveniently located. How to capture these dimensions in a digital badge portfolio is an ongoing design challenge. CCoL is now in the process of considering how micro-credential data can inform policy to create a more vibrant and healthy learning ecosystem throughout the city.

An example of a CCoL program aimed at gender inequality in STEM and design-related fields is the Digital Youth Divas (DYD). By providing programming specifically targeted at young girls, DYD aims to encourage and nurture interest in STEM and design. DYD is open to all girls and provides informal learning opportunities to students when formal schooling is not available or in session. The CCoL portal can be used to help shape learner participation by identifying opportunities that align with learner interests. By participating in DYD activities, students learning technical skills and earn micro-credentials that are automatically pushed to the CCoL portal, where they become available for later inclusion in a badge portfolio.

CCoL is in the early phases of experimenting with expanding college access, in partnership with the Illinois Institute of Technology's Global Leaders program, which focuses on high school graduation. A representative of the program spoke about the significant impact CCoL has had on both the student experience and the Chicago Public School curriculum. Using the micro-credential framework articulated by CCoL/Digital Youth Network, the Global Leaders Program focused student learning on 21st Century learning competencies which are developed during the three stages of a sustainability project - program preparation, action, and reflection. By participating in the the program, students are able to earn the 15 credits of service learning needed to graduate from high school in Chicago and three micro-credentials for each program stage. Chicago Public Schools now recognizes these micro-credentials, and is in the process of using them to re-evaluate the service learning curriculum.

5.2 Mouse

Mouse, also known as Mouse.org, is a non-profit organization with a 20-year history of working with youth in under-resourced schools and neighborhoods to create connections to STEM learning, especially with respect to computing. Mouse began in New York City, but now operates programs nationwide. At our workshop, Mouse focused on one particular program, called the Design League, which is the focus of a collaboration with the Parsons School of Design (Parsons) in which they endorse Mouse-awarded micro-credentials.

Through the Design League, learners complete a series authentic learning experiences situated around human-centered design thinking to create assistive and adaptive technologies for real clients. As students complete tasks they earn micro-credentials to recognize the competencies supporting the successful completion of said tasks. This then allows students to begin to think of themselves as legitimate designers. Determining the potential for the Design League program to promote and facilitate college going behavior was the next logical step.

Mouse turned to Parsons School of Design for help with the challenge of making the Design League into a pathway into postsecondary education. Working together, Mouse and Parsons' Committee for Undergraduate Education mapped the Design League learning outcomes to Parson's first-year learning outcomes. Seeing alignment, Parsons agreed to serve as an endorser of Design League program, allowing Mouse to embed the Parsons endorsement into the Design League micro-credential (see https://medium.com/mouse-org/your-university-can-make-an-impact-on-college-access-without-spending-ae928fcefff6 for details of the endorsement). Students in the Design League were further supported with opportunities to meet Parsons admissions officers and student mentors who offered advice on completing college applications. It is important to note that only a small number of Design League participants have actually been admitted to and matriculated at Parsons, but that was not the primary intent of the program. What has occurred is an increased awareness of post-secondary opportunities among Design League participants, and the use of the Design League credential to communicate college preparation to other schools. For instance, the Stevens Institute of Technology in New Jersey is currently interested in recruiting Design League students, in part because of the perceived value in the endorsement of the credential by Parsons.

5.3 Issues Raised by Case Studies

CCoL and Mouse, while not representing the entire universe of badge-issuing organizations, do represent examples of organizations that thoughtfully provide the social and physical infrastructure needed for learners in non-dominant communities to obtain better access to the skills and mindsets that higher education institutions seek in applicants. They do this in part by serving as points of contact between and across communities, existing informal learning opportunities and programs, and higher education. Mouse, in particular, has worked to build programs that are explicitly aligned with university curricula and admissions standards, thus increasing the credibility and potential of the credentials earned by students to serve as pathways into post-secondary education. In part because of the explicit collaboration between Mouse and Parsons, the resulting micro-credentials and endorsement is aligned with the way some higher education institutions consider student "readiness," and thus the micro-credentials have greater currency. CCoL, which primarily serves younger students than Mouse, seeks to provide information and access to a broad range of opportunities for learners, and is building a powerful toolkit to help learners organize and represent their learning in the form of micro-credentials.

The issue of endorsement was made salient at the workshop through consideration of these cases. Mouse and CCoL (and its partner organizations) issue badges that are earned by learners. But who establishes the validity of

these badges; who establishes that holding any particular badge or sequence of badges means that the learners have accomplished a well-defined and understood learning goal? Are Mouse and CCoL the "endorsers?" Is Parsons the endorser of Mouse's Design League sequence? If the UM or K College received information about a student's badge portfolio from either of these organizations, how would they determine the trustworthiness and value of that portfolio? How would they do this at scale, for potentially thousands of students from hundreds or thousands of different badge-awarding organizations? This is not necessarily a new problem. For example, in the case of scouting, how do admissions officers take into account that Eagle Scouts may look totally different in Queens than in Nebraska? Similarly, admissions officers recognize that GPAs have different meanings in different school contexts (e.g., economically challenged areas vs. elite preparatory academies). The point is that college admissions officers have developed a way to deal with these variations in some cases, and the rise of micro-credentialing organizations present a broad new set of cases that need to be understood in the context of holistic review.

The different ways that each case study in the workshop organizes partnerships is instructive of some of the difficulties in the area of endorsement and validity of different badges or badging systems. The partnership between Mouse and Parsons is internally coherent with a clearly articulated agreement of standards and a defined pathway. CCoL, however, uses a more decentralized system, relying on their partner organizations to determine what badges are awarded and what each badge represents. CCoL faces an internal scale challenge, as conducting background and validity checks on the extensive catalog of Chicago formal and informal learning experiences in their portal is beyond the current operational scope of the organization. However, CCoL recognizes the tremendous opportunity in building and providing a common platform for these diverse badge-awarding organizations. By building a platform, they can start to assert norms and standard practices for the use of badges that their partners will be encouraged to comply with in order to remain a part of the broader network (Plantin, Lagoze, Edwards, & Sandvig, 2016).

Another issue emerging from the case studies has to do with student awareness of micro-credentials' purpose and potential, or even their existence. If students do not perceive the value of micro-credentials, they are unlikely to make use of them. Student reflections on micro-credentials earned through the CCoL Global Leaders Program show that students remain skeptical of the efficacy of micro-credentials in college admissions decisions. This adds credence to the belief that micro-credentials can serve as a framework for increasing student agency and promoting 21st Century learning goals, yet more could be done to communicate the value of micro-credentials to those earning them. If "value" is a function of what colleges look at in admissions decisions, and colleges need good examples in order to develop a systematic and fair way to assess badge submissions, this could present a chicken-and-egg problem.

If students do not perceive the value of micro-credentials, they are unlikely to make use of them.

Given the wide range of opportunities with the CCoL network, for example, another challenge is building tools and systems that can recommend future learning opportunities. A powerful use of badges is to signal pathways for learning and accomplishment (Joseph, 2012). But doing this successfully requires knowing not only which opportunities are available to learners, but understanding which are the right opportunities. Currently, CCoL is working with content providers to document the learning offered through programs and the necessary language needed to connect students to those and future opportunities. This includes a consideration of what language could be used to demonstrate what students have learned, what is needed for further development, and the necessary infrastructure to capture and represent evidence of learning.

A final challenge recognized by Mouse, and echoed by other workshop participants, is that despite having done the work of aligning learning outcomes, the Design League activity is not eligible for college credit or course equivalency, in contrast to, for example, AP test scores. As a result, success in the Design League might only be seen, so far, by admissions officers more as an indication of a learner's passion and persistence than as a concrete demonstration of skill or knowledge regardless of how rich the demonstration might be. The CCoL work with Global Leaders and Chicago Public Schools is promising in this direction, providing an opportunity to use micro-credentials either in addition to or in accordance with traditional transcripts. Global Scholar participants earn both Chicago Public Schools credit and micro-credentials based on the tasks they complete through the program. While the high school credit is included on their transcript and taken into consideration by the admissions office at the Illinois Institute of Technology, there are still issues with using micro-credentials (or transcripts) to determine what exactly students did to earn credit or badges. In this way the credit remains digestible yet dissociated from the outcome. Including the micro-credential adds information that could encourage contextually-based admissions decisions.

6.0 Design Thinking and Issue Generation to Advance Micro-Credentials in Admissions

After hearing from university and college admissions officers and case study partners, workshop participants broke into heterogeneous groups to brainstorm different possible systems that would support the expanded use of micro-credentials in college admissions, and also to generate and discuss emerging issues surfaced by their designs (see the design group charge in Appendix C). Each group was comprised of admissions personnel, representatives of badge-issuing organizations, university faculty and staff, and experts in assessment. (Some participants represented more than one of these categories.) After reconvening with all workshop participants to share features of their design proposals, discussion moved towards the generation of issues felt to be most pressing with respect to advancing the use of micro-credentials in college admissions. Due to limited time, proposals reached different levels of "completeness," and served more as tools to think with than as blueprints for actual systems; thus we are not sharing the design proposals themselves in this report. In discussing the different proposals, workshop participants highlighted six issues they believe will be vital to the design and implementation of any badging system that aligns with the guiding principles and concerns of admissions departments/HEIs, community organizations, and the communities served by both. Below is a description of each issue with relevant sub-issues. The issues are listed in order of significance as indicated by workshop participants, from most to least important (though all were viewed as important). As is often the case with such design issues, they are frequently in tension with one another, where attention paid to one creates new challenges for another. As design tensions, these issues also frame the outlines of a broad research agenda that should be pursued in order to advance our understanding and use of micro-credentials in college admissions. We identify candidate research topics within the discussion of each issue below.

6.1 Equity

Enhancing equity and access to higher education is a primary motivation for using micro-credentials in the college admissions process. Badges could support the representation of "non-standard" images of applicants' interests and potential (Pitt et al., in press). However, workshop participants shared two opposing areas of concern with respect to equity: First, the potential for students who use badges to be somehow stigmatized in the application process. And second, the potential, should the use of badges become a reliable path to higher education, that they might become "weaponized," with a specialized support industry growing to advise well-resourced students about the "best" badges for college admission or strategies for developing badge portfolios (similar to what has happened with the test preparation industry). A way to avoid the first challenge is to carefully design badge systems so that their value is equivalent to other types of information about learner readiness for college, or at least well-understood in the context of other information. To avoid the second challenge, credentials must reflect validated (see "Validity and Endorsement" below) recognition of knowledge or performance, and not simply participation or access.

Enhancing equity and access to higher education is a primary motivation for using micro-credentials in the college admissions process.

Furthermore, participants agreed that opportunities to earn micro-credentials and the platforms to support them should follow principles of Universal Design for Learning (Rose & Meyer, 2002) to ensure accessibility by the broadest possible range of learners. Of note, the participants recognized the need to develop designs that guard against unintended consequences. These concerns call for research that investigates micro-credentials both for their potential to cause harm and for their potential efficacy in protecting against adverse effects. Specifically, use cases should consider the diversity of multiple stakeholders likely to engage with the micro-credential to ascertain a holistic understanding of potential affordances and limitations.

6.2 Validity and Endorsement

As established earlier, micro-credentials are not assessments, they are a record of something having been assessed. Being digital, well-designed badges contain useful properties, such as the ability to examine work products related to the assessment that led to the badge being awarded. As elaborated in Casilli and Hickey (2014), moving from standardized measures to badges means shifting from validity of evidence (i.e., using principles of measurement) to credibility of web-based information (as elaborated by Fogg, 1999; and noted by Pitt et al., in press). This shift raises obvious questions. Who determines whether the evidence contained in the badge is credible support for the claims that badge makes? The newly available ability to add third-party endorsements (Hickey & Otto, 2017) raises additional questions: Who endorses the badge? Is this left up to organizations that award badges, such as Mouse? Is it a task for organizations that coordinate across many badge-awarding organizations, such as CCoL? Or will larger entities emerge that take responsibility for establishing the credibility of badges and provide a trustworthy endorsement for admissions officers?

The Open Badges 2.0 standards that were established in 2017 specify new metadata that allows badge issuers to certify organizations and individuals, adding third-party endorsements. Will this feature result in the development of "trust networks" that are recognizable to admissions officers? Proponents of the Open Badges 2.0 standards argue that this feature allows digital credentials to transform higher education the way that consumer reviews allowed e-commerce to transform retailing and publishing.

Admissions officers need to be able to quickly assess (see "Scalability" below) both micro-credential credibility and derive contextual information related to the micro-credential. Valid contextual information is important because it helps serve as the legally defensible foundation for the composition of the incoming class. One might argue that the Boy/Girl Scouts offer examples of endorsing bodies at scale. Admissions officers know how to interpret "Eagle Scout" as a credential. They also understand that the designation of "Eagle Scout" represents more than the sum of badges earned along the way, and furthermore, we would argue that they are unlikely to look into which individual badges any particular Eagle Scout earned. Bodies like the College Board serve as endorsers for a wide range of standardized exams such as SAT and AP, and they also create those exams and oversee their administration. It could be argued that the College Board (and the Boy Scouts) have built not just systems to measure and represent accomplishment, but also brands that represent something to admissions officers. Even if we are unsure of what, for instance, an AP test score means for college readiness (National Research Council, 2002), participating in the AP process and receiving a 4 or 5 (out of 5) has come to be a proxy for *something* in the eyes of some college admissions officers, or at least a point of comparison among students. (Note: this was not the case for the admissions officers participating in this workshop.)

Future policy research might explore the opportunities and barriers for creating high-level endorsing bodies for digital micro-credentials.

At present, there is no high-level endorsing body for digital micro-credentials, and no traditional or shared meaning about what badge portfolios mean. Not only will such organizations need to be built and supported, but higher education admissions will need to develop processes for interpreting and including the output of such organizations in their workflow. Future policy research might explore the opportunities and barriers for creating high-level endorsing bodies for digital micro-credentials, and implementation research efforts might explore the establishment of such entities.

6.3 Agency and Authenticity

Will the use of micro-credentials for college admissions emphasize "earning over learning"? By this, we refer to the potential for evidence about learning to become secondary to having a large set of earned credentials or a "magic set" of credentials that admissions officers may find impressive or signals of other desirable contextual characteristics (see "Equity" above). There are at least two possible responses to this challenge. One is to emphasize the validity of micro-credentials for learning (see "Validity and Endorsement," above). Another is to recognize the importance of representing learner agency, in terms of demonstrating sustained interest in a particular area. College admissions officers at the workshop emphasized a focus on "authenticity" in reviewing student applications. A student who shows sustained and deep engagement in a particular area is likely to be viewed favorably in comparison to a student who appears to be collecting activities for the purpose of "résumé polishing." Micro-credentials, especially those that represent pathways of learning, can be a way to highlight student agency and authentic participation in personally meaningful activities. Research into the ways that admissions officers understand and interpret badges needs to be paired with projects focused on the design of badges or badge systems that capture and communicate agency and authenticity.

Micro-credentials, especially those that represent pathways of learning, can be a way to highlight student agency and authentic participation in personally meaningful activities.

6.4 Promoting Lifelong Learning

A badging system that promotes agency can also be used to promote lifelong learning. Students should be able to use and engage with the system at different stages of their life to promote and share evidence of continuous and future learning. It is therefore necessary for the system to persist over time, be interoperable with different systems, be under the control of the learner, and be secure and trustworthy for those seeking to interpret the badges contained within the system (see "The Need for Infrastructure" below). Whereas traditional college admission might represent a gateway moment in which a student's record is essentially reset, micro-credentials could provide a platform

where students build a representation of sustained but continuously evolving interests and expertise. To enable this across time, universities would need to develop the capacity to link their own student record-keeping systems to open badge platforms and portfolios. The nature of learning within universities might change to reflect the kinds of engagements learners found motivating in their pre-college lives, including a shift away from records of learning based on final grades and credit hours towards records of learning that represent accomplishment. Elon University in North Carolina is an example of an institution that is experimenting with such a system right now (Parks and Parrish, 2017). Research focused on institutional innovation and transformation is needed to explore designs for education that leverage and are leveraged by digital micro-credentials. As there will likely be no "one best" approach, a program of research might explore differences between various approaches.

6.5 The Need for Infrastructure

In discussing infrastructure, participants raised both technical and policy concerns. Specifically, questions remain concerning the optimal design of protocols for data protection and ownership. Research and development is needed in order to establish policies that incentivize access control and ownership in an a persistent, portable, and interoperable system. Research should consider how authorization to access and use private data will be granted to students, parents, universities, and partner organizations. Furthermore, if universities were to form federations/consortiums within the badging system, or if larger-scale endorsement agencies emerge, what policies would be needed to govern data sharing and privacy protection? The recent acquisition of Pearson's Acclaim badging system by Credly Inc. suggests that digital badges and the Open Badge metadata standards are being adopted as an industry standard. But this merger of industry leaders and Pearson's ongoing efforts to patent digital badges raises concerns about consolidation and suggests a need for both commercial non-commercial alternatives.

Building out the infrastructure of digital micro-credentials is an important technical challenge.

Building out the infrastructure of digital micro-credentials is an important technical challenge that is currently being addressed by higher education industry associations such as IMS Global and private-sector partners such as Concentric Sky's open source Badgr application (https://info.badgr.io), taking over where the early support from Mozilla flagged. But as with other important socio-technological systems, micro-credentials will benefit from the attention of a diverse set of researchers and developers focused on the construction of a robust ecosystem of tools and technologies to support the use of micro-credentials at all levels of the education system. It is important to avoid over-reliance on a single platform or on commercial providers, which could potentially lead to issues with proprietary data or data ownership. This is an area of focus for computer and information scientists focused on both data access and privacy.

Designers of micro-credential platforms and systems must take into account the constraints placed upon application reviewers to make it possible for micro-credentials to be a viable part of an overall well-informed holistic admissions decision.

6.6 Scalability

Finally, given the sheer numbers of applications that admissions offices must process in order to build an incoming class, it is critical that the information contained within micro-credentials be readable at large scale. In contrast to transcripts, badges can contain a large amount of non-standardized information. The use of JSON (JavaScript Object Notation) means that this information can be both read by humans and machines; the use of JSON-LD (Linked Data) further means that this information can be accessed via the web in ways that it makes it easy to locate and interoperable with other systems. Both features may play a role in the process of conducting a holistic review, whereby an admissions officer must make sense of a student's micro-credential portfolio as efficiently and as accurately as other existing indicators of academic preparation. While micro-credentials may not be as easily scannable as standardized test scores, the students' learning and commitment represented by micro-credentials is potentially much deeper than what is represented by, for instance, ACT and SAT scores. Nonetheless, designers of micro-credential platforms and systems must take into account the constraints placed upon application reviewers to make it possible for micro-credentials to be a viable part of an overall well-informed holistic admissions decision (Pitt et al., in press). The Mastery Transcript Consortium, recognizing this challenge, has committed to build a transcript that is organized around "mastery standards and micro-credits" instead of grades (analogous to badges), and is "readable by college admission officers (once trained) in less than two minutes" (http://mastery.org/a-new-model/). This

goal recognizes the importance of scalability in creating a viable alternative to standardized test scores and GPAs. Design-based implementation research efforts (Penuel, Fishman, Cheng, & Sabelli, 2011) might focus on the varying demands faced by both college admissions officers, college applicants, and badge issuing organizations. Viable solutions will need to understand and address the needs of all three audiences.

7.0 Observations and Recommendations

The workshop described in this report represents an important first coming-together of different parties in the micro-credential and college admissions worlds. In the process of our discussions, many different ideas, issues, concerns, challenges, and opportunities were raised. Below, we consider some of the most salient topics raised at the workshop and discuss a path forward for each.

7.1 Micro-credentials can facilitate student-institution match

The workshop presentations by the three participating admissions departments demonstrated the primary goal of admitting students who will be successful within their own institutions. How can micro-credentials potentially help shape and represent students' interests and commitments to learning, and provide strong signals about the likelihood of academic success within the context of a specific institution? Micro-credentials can both provide a tool for reflection and student discovery, and connect students to new educational opportunities. Through a self-curated learning profile, students could then articulate the arc of their learning over the course of their education, both prior to and throughout college. This type of reflection can promote the development of one's identity as a learner and lead to deeper engagement in the learning process (Deakin Crick, 2012).

How can a self-curated student learning profile be utilized by universities to inform their recruitment process and provide a more robust means for achieving diversity goals?

Similarly, how can a self-curated student learning profile be utilized by universities to inform their recruitment process and provide a more robust means for achieving diversity goals? All of the admissions officers in this workshop articulated their institutions' deep commitment to creating diverse cohorts of students, as measured along many different dimensions. Beyond simply illuminating differences across students, access to students' micro-credentials could provide admissions officers with relevant information for reaching out to the students who might not typically consider applying to a particular institution. Using badges that represent a broader set of skills and mindsets could help to alleviate problems such as under-matching, where students apply to a less competitive institution because they do not believe they could succeed at a more competitive one. Under-matching is a pressing challenge to increasing the diversity of applicants to selective institutions, particularly for underrepresented minority students. Note that careful consideration of student privacy, established guidelines for data sharing, and reliable data security should be key concerns in implementing systems that use badges to promote "discovery" of students by colleges.

7.2 The double-edged sword of context and uniformity

Application numbers are currently increasing at a rate that stresses institutions' admissions capacity, leading to both an increasingly competitive application process in which there is less time allocated for each application. Given this increased competition, there is great potential to exacerbate existing inequities, and college admissions officers work hard to prevent this. Furthermore, the college admissions process has become a magnet for litigation. The need for legally defensible contextual information is therefore needed now more than ever. However, the degree to which contextual information about students and the need for application uniformity conflict with one another is not well understood.

Admissions representatives frequently expressed the role uniformity plays in the efficient evaluation of applications. "Sense-making" of application factors is facilitated when those factors are recognizable and easily weighted relative to other application factors such as GPA and test scores. Adding non-uniform factors to application would therefore increase the time needed to make sense of applications and complicate the review process. Groups like the Mastery Transcript Consortium recognize this challenge explicitly in their design goals. How can micro-credentials be designed to allow uniformity while facilitating the discovery of unique contextual information about learner is a serious design tension?

Additional care should be taken to ensure that the inclusion of added context is not made at the expense of currently understood factors. A micro-credential system should support or even improve the process of evaluating the following factors: GPA and class rank; pattern of grade improvement; quality of school curriculum; strength of senior year courses; demonstrated interest in an academic area; educational environment - curriculum, rigor, and percentage of students going to college; character - personality, geographic, and adversity faced; and demonstrated interest in the college or university.

7.3 The need for agreed upon standards of endorsement and validation

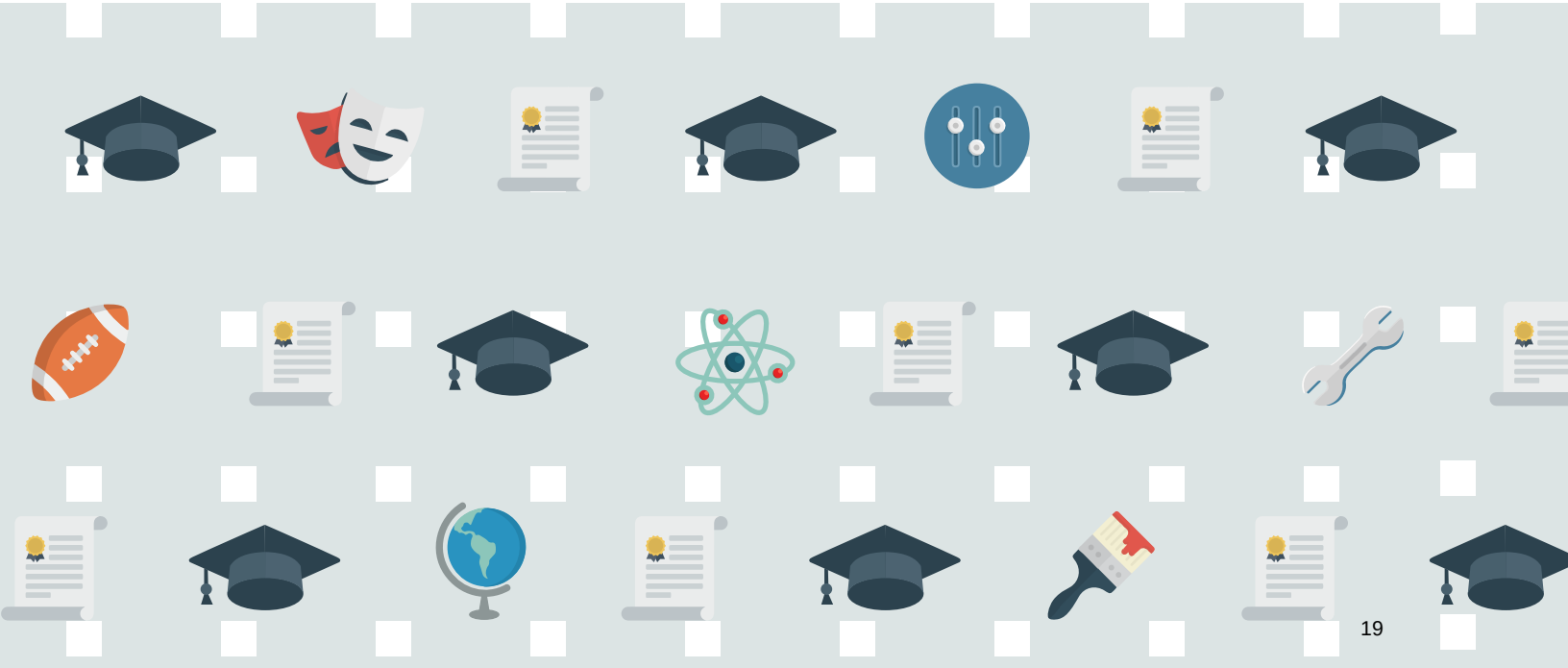
If learning outcomes are not validated, it will be difficult for universities to accept micro-credentials as evidence of college readiness. What mechanisms might support ongoing and consistent validation of the multitude of learning outcomes that could be recognized through an evolving micro-credentialing system? The potential for achieving validation through the credibility of endorsers presents a possible solution. Partnerships such as the one between Mouse and Parsons School of Design demonstrate how an issuer can gain credibility by association with an already established endorser of academic achievement. Institutional peer networks or regional consortiums are another possible mechanism for addressing this issue.

7.4 The potential of micro-credentials to affect academic pathways

Finally, the type(s) of learning fostered by a micro-credentialing system would likely be informal and interest-driven, or at least more so than the current system of grades and GPAs. One important question to consider is how well students who thrive in these new kinds of learning contexts might perform in the more formal and traditional curriculum that is typical of the student experience in higher education today. The workshop participants considered how higher education might need to change once students begin to be accepted based on their success in programs that award micro-credentials. Scholars have begun to explore frameworks for improving student retention through the incorporation of micro-credentials into existing first-year experience programming (e.g., Mah, 2016). These explorations could serve as a starting point for imagining the place of alternative credentialing of learning in postsecondary education. Indeed, though this workshop focused on the process of gaining admission to post-secondary education, the introduction of micro-credentials as a mechanism for marking and communicating learning has the potential to lead to much broader shifts in the assessment infrastructures that shape the ways we teach and learn.

8.0 Conclusion

A key motivation for this workshop was to explore avenues for broadening participation in higher education. Micro-credentials are one possible vehicle towards the goal of including more diverse populations in college. As we work to enhance the use of digital micro-credentials or badges as part of the college application process, it is important to remember that the greatest benefits are likely to come from thinking big. We could view badges as "one more" way to indicate student accomplishment or readiness, and retrofit them into our existing college application process. Or, we could use the emergence of digital micro-credentials as an opportunity to rethink not just college admission, but the structures that currently shape learning both within and beyond formal education. Change involves identifying and questioning both the components of the system and how they relate to each other. New organizational arrangements, along with (and sometimes encouraged by) new technologies, are leading to new "cultures" of learning (Thomas & Brown, 2011) and new opportunities for authentic connections across many dimensions of learners' lived experience (Ito et al., 2013). Digital micro-credentials provide a way to bridge these different learning opportunities, helping lay a foundation for both lifelong and lifewide learning with more equitable opportunities for all.



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9.0 Appendices

Appendix A - Workshop Agenda

Day 1 - May 16, 2017

- Orientation (Barry Fishman & Stephanie Teasley)
- Stage-Setting: 3 Key Questions
  - Can micro-credentials serve as valid and reliable measures of learning for college admissions?
  - What "gap" in current assessment practices related to college admissions can be filled by micro-credentials?
  - What is required for micro-credentials to be useful for college admission?
- The State of Digital Micro-Credentials (Dan Hickey, Indiana University)
- The State of College Admissions (Kedra Ishop, Erica Sanders & Karina Galvin Moore, University of Michigan; Eric Staub, Kalamazoo College)
  - What is current practice?
  - What are challenges, especially for broadening participation in college?
  - What is on the horizon for innovating current practice?
- Discussion of Similarities and Differences Between Admissions Departments (group)
- Case studies of micro-credentials
  - Mouse (Mark Lessor & Maggie Muldoon)
  - Chicago City of Learning (Nichole Pinkard & Akilli Lee)
- Discussion of Issues and concerns from case studies (group)
- Design Teams (See Appendix C for Design Charge)

Day 2 - May 17, 2018

- Design Teams resume
- Design Presentations
- Synthesis & Agenda Setting

Appendix B - Workshop Participants

- Dan Atkins, Professor and Dean Emeritus of Information, School of Information and Professor Emeritus of Electrical Engineering and Computer Science, College of Engineering, University of Michigan
- Gail Baxter, Assistant Director for Research, Center for Innovation in Engineering & Science Education, Stevens Institute of Technology
- Bernard Bull, Assistant Vice-President of Academics & Chief Innovation Office, Concordia University
- Steven Cederquist, Master's Student, Center for the Study of Higher and Postsecondary Education, University of Michigan
- Alina Chau, Undergraduate, College of Literature, Science, and Arts, University of Michigan
- Janet Coffey, Program officer, Science Learning, Moore Foundation, Moore Foundation
- Dana Davidson, Project Coordinator, Wolverine Pathways, University of Michigan
- Girlie Delacruz, Senior Research Associate, LRNG
- James DeVaney, Associate Vice Provost for Academic Innovation, University of Michigan
- Barry Fishman, Arthur F. Thurnau Professor of Information and Education, University of Michigan
- Jaime Gutierrez, Research Associate, Education Development Center
- Dan Hickey, Professor & Program Coordinator, Learning Sciences Program, Indiana University
- James Holloway, Vice Provost for Global Engagement and Interdisciplinary Academic Affairs, University of Michigan
- Kedra Ishop, Vice Provost for Enrollment Management, University of Michigan
- Rob Jagers, Director, Wolverine Pathways and Associate Professor, Education & Psychology, University of Michigan
- Ryan Jimenez, Undergraduate, School of Information, University of Michigan
- Jennifer Kabaker, Director, Educator Micro-credentials, Digital Promise
- Mika LaVaque-Manty, Arthur F. Thurnau Professor and Associate Professor of Political Science, Director of LSA Honors Program, University of Michigan
- Akili Lee, Director of Technological Innovation, Chicago City of Learning, DePaul University
- Marc Lesser, Senior Director, Learning Design, Mouse
- Juliana Lew, Recruiting Coordinator, STAMPS School of Art & Design, University of Michigan
- Charlie Lindquist, College Access Advisor, Illinois Tech Global Leaders Program, Illinois Institute of Technology
- Steve Lonn, Director of Enrollment Research and Data Management, University of Michigan
- Leon Ma, Undergraduate, School of Information, University of Michigan
- Tim McKay, Arthur F. Thurnau Professor of Physics, Astronomy, Education, University of Michigan
- Caitlin Martin, Research Director, Digital Youth Network, DePaul University
- Vera Michalchik, Director of Evaluation and Research, Office of the Vice Provost for Teaching and Learning, Stanford University, Stanford University
- Joanna Mirecki Millunchick, Arthur F. Thurnau Professor of Materials Science and Engineering, University of Michigan
- Karina Galvan Moore, Director of Admissions and Enrollment Management, STAMPS School of Art & Design, University of Michigan
- Maggie Muldoon, Design League Coordinator, Mouse
- Kylie Peppler, Associate Professor of Learning Sciences, Indiana University
- Nichole Pinkard, Associate Professor of Computing and Digital Media, DePaul University, DePaul University
- Michelle Riconscente, Chief Scientist, Motimatic
- Paul Robinson, Associate Vice Provost and University Registrar, University of Michigan
- Erica Sanders, Director, Undergraduate Admissions, University of Michigan
- Valerie Shute, Mack & Effie Tyner Campbell Endowed Professor of Education, Florida State University
- Will Spots, Assistant Director, Eastern Michigan University Bright Futures, Eastern Michigan University
- Eric Staab, Dean of Admission and Financial Aid, Kalamazoo College
- Stephanie Teasley, Research Professor, School of Information, University of Michigan
- Jessica Walker, Assistant Professor of Fine Arts, Director of Pre-College Programs, Parsons School of Design
- Felecia Webb, Research Professor, University of Michigan

Appendix C - Design Group Charge

Using the cases from Mouse and CCoL as "data," your task is to develop and describe a system (or systems) that enable the use of micro-credentials (badges) in college or university admissions.

By "system," we don't mean a technological tool. Rather, we mean the interconnected components and/or practices that comprise a "system" that might encompass the following phases of a student's relationship to a college or university:
Pre-application (high school or earlier)
Application (student acts with intention towards post-secondary study)
Review & Admission (by the institutions where students submit applications)
Matriculation & Beyond (what happens after a student enters higher education)

Your design group might come up with several different approaches: One where badges can stand alone as evidence for college admission, one where badges contribute value to the current admissions process, or other approaches. As you work, feel free to imagine elements that don't quite exist yet… a wish/need list for future use in order for your design to be fully functional.

(See next page for questions to consider.)

1. Using the Mouse and CCoL cases as a starting point, what kind of case can you make about the relevant college admission qualifications of the students in these programs?
    a. How do you make a case about the validity of the information?
    b. What information is missing that would help bolster judgments about validity?

2. Who endorses the meaning or validity of the badges in your system?

3. How do badges represent information beyond current metrics (GPA/tests/essays)
    a. What kind of information do they represent beyond what already exists?
    b. How do you facilitate consistent interpretation across different consumers (is this even important)?
    c. How well does this information translate into the prerequisite needs for success in college?
    d. Is your system an add-on or replacement to existing admissions data?

4. Whose needs are served by the system you propose? (students, admissions, faculty, etc.)
    a. Does the badging system address issues of equity and inclusion? How?

5. What partners or stakeholders are necessary to make your system function?
    a. What kinds of buy-in are required from each stakeholder?

6. How does your system support scalability?
    a. Does the system allow for the review of thousands of applicants? What process is enabled/required to make interpretations using the system?
    b. How flexible is the system with respect to new badges or evolving badges?
    c. Does the badging system support qualitative (holistic) review, or is there a risk that badge systems become something else to quantify (applicant A has more badges than applicant B)?

7. What evaluation metrics could be applied to assess the system itself?

8. What is the potential for digital credentials to influence academic pathways broadly?

9. What is the potential for digital credentials to influence your institution internally?