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MOVING FROM THE LEGACY STUDENT HOUR TOWARD A COMPREHENSIVE MEASURE OF STUDENT LEARNING: EXAMINING BENEFITS OF A COMPETENCY-BASED TAXONOMY OF LEARNING

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Executive Summary

This publication examines current challenges with the articulation of learning and argues that a new means of articulating learning is necessary. Specifically, drawbacks and inefficiencies developed to accommodate the credit hour measure of student learning are examined. As an alternative, a new competency-based measure of learning is proposed. Benefits of such a system would include:

- Efficiencies and clarity when transferring between postsecondary institutions.
- Improved effectiveness of costly prior-learning assessment processes.
- Simplification of capturing and sharing learning that occurred while serving in the military.
- Enhancing the effectiveness of competency-based hiring processes, particularly in the contemporary workforce that is global and increasingly values contingent employment.
- Improved articulation of work-based learning, including apprenticeships and internships.
- Ability to adapt to existing technology and information systems.
- Applicability toward digital and analog competency development and management systems.
- Adaptability to new, innovative, and global learning models.

Further, a new taxonomy of learning, based on an index of competencies, would naturally aid competency-based hiring practices. These opinions are informed by existing literature as well as feedback from thought leaders representing various sectors.

The Challenge: Disconnected and Opaque Systems

Currently, learning beyond high school, primarily postsecondary education, is dependent on a time-based unit of measure commonly known as the credit hour. This measure of learning is the legacy of the Carnegie Unit, a unit developed to assess workload for the purposes of determining faculty retirement benefits (Laitenan, 2012). The credit hour, along with an associated letter grade, has become the standard method for articulating student learning on postsecondary academic transcripts. This means that transfer and hiring decisions are often made using a unit that measures time — along with a vague (often inflated) measure of academic performance — rather than an articulation of the actual knowledge or skills a person has achieved.

While the use of the credit hour as a means to document postsecondary learning is commonplace in the United States, this measure is virtually meaningless to those outside the American postsecondary education system. Adding to the confusion, courses with the same content and the same number of credit hours achieved at one postsecondary institution may not necessarily transfer to another due to systemic inequities fostered through biases and competing financial interests.

Additionally, military training, apprenticeships, and industry certifications which are often formally endorsed do not use the credit hour measure. Institutions of higher education articulate these experiences into credit hours when such individuals enter or re-enter the postsecondary educational system. More specifically, workplace or military learning is articulated into the credit hour measure through a process known as prior-learning assessment (PLA) (American Council for Education, n.d.). The irony in this is that, in order for individuals to have workplace learning considered toward higher education credentials, it is first converted into the credit hour measurement unit and articulated as such on the learner record, which ultimately has little value for the very employer receiving a job seeker's credentials after graduation. This conversion is required to articulate the learning toward a credential, the same credential that is used to demonstrate that an individual is qualified to seek high-paying jobs. This circular, puzzling, and often difficult-to-navigate system is frustrating for both students and employers — especially for adult learners who bring with them a wealth of knowledge earned outside higher education.

The opaque nature of academic transcripts and the consistent compulsion to align all learning achievement to the credit hour has created a learner record that reveals little of what a student has actually learned and no detail on expected performance in the workplace. Perhaps these challenges explain why employers, as well as the American public, consider college graduates ill-prepared for the workforce while many academic officers in higher education hold an opposing view (Gallup, 2014; Jaschik & Lederman, 2014).

A Solution: A New Learning Taxonomy

By creating a new learning taxonomy, the knowledge, skills, and attitudes achieved by learners in P-20 and other learning environments can be standardized and articulated across sectors without implementing additional technology or applying significant resources.

Standardizing the articulation of learning for an individual regardless of age cohort, levels of formal education completed, and credentials earned — yet affirming a discrete and defined unit of measurement for both performance and knowledge — has the potential to meet the needs of numerous stakeholders. Such stakeholders (including learners, educational institutions, the military, and employers) will find a coding and classification system based on competencies relevant because it supports a system that produces highly qualified individuals for workforce needs without relying on time-based measures of learning.

Some efforts, already underway, are early signals that educational leaders see the potential of changing how credentials are measured and articulated. The Connecting Credentials initiative has completed difficult work toward developing a framework and identifying issues that prevent credentials from being shared (Connecting Credentials, 2016b). Indeed, one of these issues is the lack of a common language concerning credentials (Connecting Credentials, 2016b). While the Connecting Credentials Beta Framework creates a mechanism to classify competencies by knowledge, skills (referred to as specialized skills), and abilities (referred to as personal and social skills) into eight levels of achievement, this framework is insufficient. It does not provide the clarity needed to enable students and employers to easily identify specific competencies, how the knowledge or performance was assessed, the context in which the competency was achieved, or if the knowledge, skills, or competencies achieved require updating through continuing education.

Furthermore, as competencies are mapped to the framework, there is no clear mechanism for capturing and identifying such competencies going forward (Lumina, 2015). A systematized universal measure of learning, based solely on knowledge, skills, and competencies, could provide this common language. Indeed, the development of a common credential language would benefit learners, employers, educators, and government organizations that provide financial aid (Connecting Credentials, 2016a). However, such a language of credentials would benefit from a syntax or taxonomy that includes additional descriptors (decay rate, issuing entity, assessment information, etc.), provided the system includes both competencies as well as the knowledge and skills that often contribute to competencies and competency sets.

Relevant Uses for a New Taxonomy of Learning

A comprehensive taxonomy of learning would have various uses and could dramatically improve processes within postsecondary education, work-based learning, and military learning, as well as workforce hiring and recruitment practices.

Postsecondary Learning

Documenting all learning beyond high school based on the achievement of knowledge, skills, and competencies can provide greater transparency and clarity for postsecondary learners and employers alike. Standardizing data among educational providers and their systems could create new opportunities to bridge educational and workforce systems. For instance, a common taxonomy could mitigate degree inflation, in which a college degree becomes the default requirement for positions that had not previously required degrees (Fuller et al., 2017). Due to a lack of transparency in learning beyond high school, employers often use college degrees as a proxy for learning (Fuller et al., 2017). Instead of defaulting to a generic bachelor degree requirement in job postings, employers should consider the benefits that would result if learner records could be evaluated to pinpoint candidates specifically through the demonstration of specific knowledge and skills achieved by the learner. The potential of a universal taxonomy — bridging education and industry — presents opportunities to realize new connections.

Beyond bridging the gaps between education and employers, a common taxonomy would create opportunities for increased interoperability within educational institutions (affecting, for example, learning management systems, transcript generation, registration, etc.). Many academic enterprise systems on two- and four-year campuses rely on one-way connections to other systems (e.g., class rosters are passed to the learning management system but often no information is migrated back to the student information system from the learning management system). This may be due to technology security policies, institutions lacking the resources to implement more interoperability, institutional leaders being unaware of the benefits of warehousing and analyzing this data, or some combination of all these factors. Further, while student information system providers may have integrated learning outcome tables within their systems, those tables are largely text-based and dependent on institutional leaders to identify, codify, and articulate learning at the course level. A coding system for competencies, as well as for knowledge and skills, would create efficiencies and greater opportunities to leverage learner data to facilitate improved teaching and enhance educational support systems for students. In addition, a competency-based taxonomy would eliminate the many issues caused by the competency-to-credit-hour transcription performed by most competency-based postsecondary degree programs, minimize challenges in assessing learning and transferring credit hours between institutions, and encourage employers to identify discrete competencies necessary for their talent-management strategies.

Lastly, perhaps the most compelling reason pertains to the credential-completion agenda perspective, in that a well-defined learning taxonomy could virtually eliminate the loss of credit due to transfer. According to the Government Accountability Office (GAO), transfer students lost approximately 43 percent of their previous credits in the process of transferring to another postsecondary institution (U.S. Government Accountability Office, 2017). The GAO cites a lack of articulation agreements and student transfer guidelines, but these observations mask the root problem of advisors and registrars needing to make judgments based on syllabi, personal familiarity with other institutions, and varied perspectives to determine whether credits earned outside an institution can be transferred. These decisions can be biased, and students who lack sufficient evidence of their learning from prior institutions are often required to retake courses at their new institution, delaying their progress toward a

degree. A common taxonomy used by all postsecondary institutions would virtually eliminate such arbitrary decisions by detailing student learning and increasing transparency at a more granular unit of measurement. This would also create more opportunities for students and advisors to have meaningful discussions about learning achieved at other institutions.

Workforce

Employers play a critical role in signaling the talent needs in the workforce. While some large employers have worked with postsecondary institutions to articulate their talent needs, these relationships are hampered by the lack of a common language in terms of knowledge, skills, and competencies needed in the workforce and the learning outcomes, skills, and competencies achieved in postsecondary environments. Few job postings list specific competencies, and many employers use degrees as a surrogate measure, simply assuming that degrees and certificates are meaningful measures of specific workplace skills. Transcripts that go beyond measuring courses, credit hours, and grades would allow the workforce to identify individuals with the specific competencies needed for success.

Today's employers seek candidates who have mastered competencies related to particular job duties. Yet "employers have difficulty understanding the competencies potential employees may or may not have mastered through the credentials they have earned" (Ganzglass et al., 2016, p. 3). Ironically, while opportunities to formally capture and assess the mastery of competencies are not readily available, employers use an imprecise and costly sequence of steps to identify and verify competencies from application materials, transcripts, and interviews (see Figure 2).

Simplified Traditional Competency-Based Hiring Model

Declaration of Competencies	• Resumé • Employment application • Screening software	• Academic transcript • Other formal credentials	• Interviews • Employer testing
Unit of Measure, Credentials	• Self-reported work history, educational history, and mastery of competencies	• Based on credit hours and grades, mastery of competencies and/or seat time	• Various
Purpose	• Initial application and screening based on competencies	• Proxy to validate competencies declared in resumé	• Assess competencies

Figure 2

Employers will benefit from a new taxonomy because it would create a bridge between the knowledge, skills, and competencies achieved and those required in the workplace. A taxonomy allows for the articulation of the knowledge, skills, and attitudes required for specific jobs at a granular level. It can clarify career pathways and has the potential to align educational experiences with current and future competency models.

The use of freelance, free agent, contingent or part-time employees continues to grow due to increasing healthcare-related costs to employers as well as an increasingly qualified pool of candidates for contingent work (WorkplaceTrends, 2017). It is estimated that by 2020, 40 percent of the U.S. workforce will consist of contingent employees (Intuit, 2010). As the workforce becomes more global, a universal taxonomy of learning can provide much-needed transparency regarding competencies acquired using new, or little-understood, educational models from within and outside the U.S. (e.g., appreciative and transformative education; Pawlak & Bergquist, 2013), or region-specific programs (Milana & Nesbit, 2015).

Work-Based Learning

Work-based learning (WBL) can take many forms, including apprenticeships, internships, or university programs including cooperative education, service-learning or even job shadowing, mentorships, or employer site visits. More specifically, such programs support "learning through reflection, learning through experimentation, learning from colleagues and learning from the supervisor" (Nikolova et al., 2014, p. 4). Raelin (1997) says the power of WBL is that theory can be acquired simultaneously with practice and that theory can even be introduced later "in order to question the assumptions of practice" (p. 564). Indeed, such models continue to experience growth in the U.S., yet there are no precise methods to measure and articulate learning acquired throughout the various WBL models. For instance, apprenticeships provide credentials that are difficult to comprehend for employers outside the field in which the apprenticeship occurred, and additional assessments (such as PLAs) are often required when attempting to incorporate WBL into the postsecondary context.

Apprenticeships

Often misunderstood and overlooked, the paid apprenticeship model provides on-the-job training as well as instructional learning that is applied toward industry-issued, nationally recognized certificates of completion. In fact, there are over 505,000 registered apprentices working toward such credentials. (U.S. Department of Labor, 2016). While this educational approach is gaining momentum due to its documented ability to raise wages, increase productivity, and improve the profitability of organizations sponsoring apprenticeships, challenges will persist for those apprentices who choose to transition to other industries or eventually seek to complete a traditional education (Steinberg & Gurwitz, 2014).

Internships

Postsecondary students are often encouraged to complete either paid or unpaid internships as part of their curriculum. While these programs provide relevant and meaningful learning opportunities, when reported on a transcript they are often distilled to a simple credit-hour measure with a generic label indicating that some form of internship learning was completed. Moreover, the specialized skills or knowledge that students gain during internships are not reflected on the transcript. While students should capture and share these learning experiences on their resumés, they may not know how to identify the competencies gained or how to effectively articulate these competencies in a way that is meaningful to employers. Furthermore, the employer has no formal evidence that the competencies shared on the resumé have actually been achieved. This may require probing questions during interviews, contact with the internship supervisor, or evaluation of the candidate for the skills using an assessment tool. By having the postsecondary institution that sponsored and developed the internship opportunity verify and validate the specific knowledge, skills, and competencies earned using a common taxonomy, employers could further optimize their recruitment efforts. This could significantly reduce the cost of verifying whether necessary competencies had been gained during an internship.

Professional Development

Today's evolving and technology-driven work environment requires employees to continually update their skill sets. Thus, most organizations provide professional development opportunities that generally consist of skills-based training, job assignments, and developmental relationships (Buffalo State, 2017). Sometimes obtaining such training leads to an employer-generated or industry-specific certificate. However, in many cases, it is simply a learning experience. Competencies obtained via informal professional development carry little value outside that organization or sector. By mapping professional development experiences to competencies that are similar — or identical — to competencies from other sources, the value of such learning becomes clearer. A common taxonomy of learning creates opportunities for trusted organizations, such as professional associations, to have the learning experiences they provide recognized as co-curricular activities using formal credentials such as badges, certificates, or even academic degrees.

Prior-Learning Assessment

Prior-learning assessment, commonly referred to as PLA, is an activity that validates "college- level knowledge and skills an individual has gained outside of the classroom (or from non-college instructional programs), including employment, military training/service, travel, hobbies, civic activities, and volunteer service. PLA recognizes and legitimizes the often-significant learning in which adults have engaged in many parts of their lives" (Klein-Collins, 2010, p. 6). Through the identification of competencies achieved and the associated rigor, institutions of higher education could streamline the evaluation of prior learning that occurred in the workforce or a workforce-sponsored professional development program (Younger, 2015). Improving and optimizing the PLA process could yield valuable results, because the PLA process works. An analysis of 62,475 students at 48 postsecondary institutions shows that students who were awarded credit for prior learning saved between 2.5 to 10.1 months of time to degree completion and were more persistent in terms of credit accumulation (Klein-Collins, 2010).

Through the use of a unified measure of learning, in many cases, the PLA process would become more efficient and perhaps could even be automated. For instance, knowledge and skills gained and certified through a formal apprenticeship might reveal that competencies normally developed through a series of college courses already have been achieved.

Military Learning

Those who have served in the military often face challenges when entering the civilian workforce because it is difficult to articulate their military training and field experiences into skills and knowledge applicable to civilian career sectors. James Hubbard, a special projects manager at the U.S. Department of Labor, points out that "the process can appear complex," as "there are 53 states and territories with more than 3,000 organizations issuing credentials, and the procedure is different for each state and each of the 105 military transferable occupations" (Military.com, n.d.). Through use of a shared learning taxonomy, employers could accept specific and valid credentials earned through military service. This would substantially improve transparency and clarity to the veteran job seeker. It could also significantly reduce processing times for the various municipal, state, or federal agencies that license specific occupations.

Military veterans often struggle with the transition to the civilian workforce because many employers hesitate to hire veterans. Unless they have a military background, many employers simply do not understand the military acronyms or terminology used on a veteran's resumé. Ironically, employers are often seeking specific skills gained during military training, so there is an opportunity for improved results when better matching military experience to competencies (Military.com, n.d.). Using a unified measure of learning, veterans can demonstrate learning that is equivalent to other professional credentials and can articulate competencies in a way that employers will understand. This would help employers better target those military veterans with skills that truly matched the skills necessary for successful employment.

Competency-Based Hiring and Recruitment

Being able to quickly recruit, identify, and hire job seekers has become ever more important because massive segments of the workforce are mobile, will more frequently switch employers, or simply prefer to work as an on-demand resource. On average, individuals now entering the workforce will switch employers every two years (CareerBuilder, 2014; Berger, 2016), with some preferring to work as contingent employees (Smith, 2016). Yet current recruitment and hiring cycles often are designed with an expectation that employees will remain at an organization for many years — perhaps even a lifetime. However, evidence has shown that job seekers prefer flexibility and a limited commitment, and would even sacrifice greater pay to meet such preferences (Smith, 2016). Also, due to an expectation of a long work tenure, employers thought a substantial amount of work time would be dedicated to onboarding and on-the-job training. Yet, with increasing employee turnover rates and the increased adoption of contingent staffing, the most competitive and efficient organizations will seek to hire individuals who can demonstrate the knowledge, skills, or competencies necessary for success.

However, doing so is increasingly complex. Employers often receive an array of credentials from prospective candidates. However, the specific skills and knowledge gained while earning a credential are often unclear (Connecting Credentials, 2016a). This is particularly true as learning achieved inside and outside the classroom is converted into credit hours for certification on a formal transcript (see Figure 1). Ironically, at the lowest levels, various types of learning are centered around measurable competencies. However, these are distilled to less descriptive and unclear measures when shared via an academic transcript. By harnessing the power of a new, universal measure of learning based on the mastery competencies, employers could far more easily identify job candidates — and reduce risks — through formal validation of the competencies as verified by a postsecondary institution.

For example, consider a global hotel chain seeking an associate manager. Using only a formal academic transcript, the recruitment effort would require the employer to prefer graduates with degrees in hospitality or event management to limit the candidate pool. However, narrowing this search may exclude candidates who have extensive hospitality experience but have formal education in other disciplines such as accounting. Instead of relying on the generic labels applied to degree programs (or even courses), hiring managers could screen candidates based on the specific competencies needed to achieve success in the open position. This would be beneficial as organizations maintain an expectation that new hires can perform their duties and meet expectations on the first day of employment (Hart, 2010).

Simplified Model of Capturing Learning and Conversion to Transcript			
Learning	• Postsecondary academic coursework • Postsecondary work-based learning	• Workforce certificates • Military learning • Apprenticeships	• On-the-job training • Professional development • Volunteerism • Civic service
Unit of Measure, Credentials	• Course-specific learning objectives and goals • Performance measures (grading rubric)	• Formal credentials (based on mastery of competencies and/or seat time)	• Self-reported (mastery of competencies)
Validation	NA	PLA Process (conversion to credit hours)	
Result	Academic transcript (credit hours and grades when applicable)		

Figure 2

Benefits to the Educational Ecosystem

Numerous efficiencies can be achieved through the use of a competency-based taxonomy that is aligned with all knowledge, skills, and attitudes a learner may achieve. For instance, the tabulation and review of transcripts using a universal taxonomy of learning achieved at other postsecondary institutions would eliminate the time-consuming review of syllabi to determine transfer equivalencies. Transfer equivalencies could be determined by aligning the competencies achieved in all previous courses. This also allows learners to address any deficiencies through any number of learning opportunities and enables a more holistic view of a student rather than simply the sum of the learning that has occurred in a specific discipline. As the contemporary learner seeks to customize learning paths through multiple institutions and learning models, having a common measure of learning is increasingly important.

Lumina's (2015b) *Making the Case* publication suggests that a reimagined credentialing ecosystem should contain five elements: 1) be easily understandable; 2) assure quality; 3) be up to date; 4) be interconnected; 5) enable comparisons. As the often-used student-hour measure of learning meets none of these elements, a new measure of learning is clearly necessary.

Benefits to Educational Stakeholders

Educational stakeholders, both internal and external to P-20 institutions, would benefit from a unified measure of learning that has the potential to disaggregate learning from time or age cohort. This feature is consistent with many innovative learning initiatives and would create new opportunities for assessment and accountability. Likewise, such a measure can augment the data available in enterprise systems without necessitating a wholesale change in curricular mechanisms. Like any other implementation, adoption requires significant staff resources (time and system configuration) but limited resources for ongoing use. Even so, the potential efficiencies across the educational landscape are staggering.

A new taxonomy based on competencies could provide a framework for the standardization sought by those invested in business operations and enterprise systems (e.g., registrars, vendors of student information systems and learning management systems). It could also provide a structure for program assessment (e.g., regional and professional accreditors), and additional data points that could develop into criteria for financial aid disbursement, along with more effective learning analytics.

Benefits to Workforce Stakeholders

Tools and systems that provide occupational outlook information to prospective students could be augmented using a standard taxonomy. For instance, the U.S. Department of Labor's National Center for O*NET Development has developed the O*Net Online index that currently includes over 900 occupations (National Center for O*Net Development, n.d.). In addition to knowledge, skills, and abilities, occupations are mapped to work context, occupational outlook, and even state-by-state certifications. Systems such as O*Net would be greatly enhanced by integration with a universal taxonomy of competencies. With a competency taxonomy, job seekers could quickly identify gaps between existing competency endorsements and required competencies, and competencies shared by fast-growing occupations could be easily identified to target learning that is applicable for new and emerging occupations.

Benefits to Learners

Finally, a taxonomy of competency-based learning could streamline the inclusion of non-collegiate or non-credit learning within learner profiles, as such an index could augment or exist independent of collegiate credit hours. This further facilitates initiatives such as service learning, professional credentials earned during degree-seeking enrollment, and learning beyond the classroom (a feature in many collegiate general education programs). A universal taxonomy would increase the ease with which learners, particularly adult learners, can have their knowledge, skills, and attitudes acknowledged by institutions.

Transfer students will benefit from a standardized index that documents learning. Specifically, transfer students often realize a transfer penalty; credits are often lost or accepted as elective credits rather than credits that meet degree requirements (Bidwell, 2016). Addressing this problem has been challenging as those empowered to drive change "can't believe that universities and colleges still haven't worked out a way of accepting each others' credits, a problem that wastes $6 billion a year in tuition, the National College Transfer Center estimates, and is a little-noticed but major reason students go deep into debt or never graduate" (Hechinger Report, 2016). Here too, standardized classification of competencies would be a potential solution to this universal problem and can facilitate improved transfer by providing transparency of achieved learning.

Furthermore, a competency taxonomy could help underserved learning populations who have gained competencies through nontraditional learning experiences such as pre-college enrollment, military service, on-the-job training, professional certifications, and continuing education requirements for professional licensure. Additionally, students pursuing portfolio-based prior learning assessment would benefit. For instance, students could use a syllabus to understand which specific competencies are achieved in a course, then identify the competencies they have achieved through other college-level learning experiences using a portfolio.

The aforementioned scenarios demonstrate that the credit hour unit of measurement is antiquated and not necessarily aligned with the skills and knowledge that a learner has achieved. "Clearly, we need a

new system that can demonstrate whether students are gaining proficiency in applying their learning to complex, unscripted problems and new settings" (Schneider, 2012). Students would benefit because a competency taxonomy recognizes the individualized nature of learning and eliminates the ambiguity found in academic credential requirements (e.g., high school diplomas, college degrees) that currently serve as measures of age-cohort progression or time rather than learning. Such a taxonomy could standardize learning experiences without being prescriptive in delivery. Similarly, a taxonomy of competencies could help identify gaps in the availability of learning experiences in underserved communities. Finally, a transparent and prescriptive classification schema would empower students to select efficient learning pathways.

Development Methodology

The authors observed that one of the fundamental issues with competency-based education is the inability to articulate competencies within current higher education systems. After consulting with peers and experts in the areas of competency-based education, postsecondary student information systems, student transcripts, and the interoperability of postsecondary systems, the authors sought to develop a coding system. By its very nature, the system we envisioned would be disruptive to current understandings of education and learning, but not destructive or otherwise duplicative, based on the authors' knowledge of postsecondary education, workforce development, and learner needs.

The authors sought to synthesize the concepts used in multiple frameworks into one inclusive taxonomy, articulating learning at the competency level. Several entities, many funded by Lumina Foundation, have built competency frameworks that seek to bring order and consistency to poorly articulated learning. The authors presumed these frameworks are valid, as they represent the knowledge experts have in their respective sectors. Yet these frameworks are siloed to specific sectors, often are not comprehensive in their approach, and do not bridge the gap between postsecondary-level learning, job skills, and work-based knowledge.

Further, the authors reviewed the structured data of more comprehensive projects, such as Credential Engine, noting the existence of competency-specific data within the Achievement Standards Network Descriptive Language (ASN-DL). While the developers of the ASN-DL addressed the relationship between competencies, no regular, unique or discrete relationships among knowledge, skills, and competencies were included in the prototype taxonomy. Rather, developers choose to treat each as an independent item that can be grouped within a multitude of contexts. In its essence, this work focuses on naming and bringing order to knowledge, skills, and competencies rather than addressing hierarchies, relationships, and the dependencies that are contextual in nature.

A second limitation to the widespread adoption of a descriptive language, such as ASN-DL, is that some technical knowledge of both the competency framework and the descriptive language is required. In other words, the information captured in the descriptive language is not easily or immediately understandable to an individual. Instead, human-readable attribute fields are provided that facilitate the inclusion of text strings along with the competency data. While the original intent of such human-readable attribute fields was to facilitate the capture of a narrative competency description, such fields could instead be used to capture the human-readable competency taxonomy value.

The Taxonomy Prototype

As observed by the authors, any unique identifier created for use by multiple sectors must contain data that convey critical information valuable to more than one sector. The following prototype competency classification index is proposed by the authors.

PBS	4809	KNO	00	08	20180519	P	073132136
Domain/Subject/ Discipline	Numeric character to distinguish this item from others	KNO – Knowledge SPE – Specialized Skill PER – Personal Skill SOC – Social Skill COM – Competency	Annual decay rate	Level of Proficiency	Date item was assessed	Summative assessment format: A – Artifact E – Exam P – Performance	Dun & Bradstreet Identifier of assessment identity

The example above details knowledge related to problem-solving skills achieved with a high level of proficiency that has no decay rate and was demonstrated through performance and verified on May 19, 2018, at Eastern Michigan University. The following sections detail, in sequence, each set of characters in the taxonomy prototype.

Of note, characters 1-14 of the taxonomy describe the knowledge, skill, or competency, the decay rate for that item and the level of proficiency at which it was achieved. The authors refer to this portion of the code as 'the learning' side of the code. Characters 15-32 describe 'the assessment:' when it occurred, how it was assessed, and the entity that provided or verified the learning. When combined, the taxonomy describes specific knowledge, skill, or competency achievement.

Characters 1-3: Domain, Subject, or Discipline

This portion of the competency taxonomy details the domain, subject, or discipline in which the knowledge, skill, attitude, or competency exists. While the standard occupational classification (SOC) system maintained by the U.S. Department of Labor and the classification of instructional programs (CIP codes) maintained by the U.S. Department of Education exist, no common set of competencies exists for all sectors of the workforce. Thus, prior to any implementation, a process toward universally accepted competency domains would need to be established. This may be done through harmonizing various competency sets from varied sources such as state workforce board resources (e.g., the Commonwealth of Virginia Competencies), postsecondary associations such as the National Association of Colleges and Employers, or international professional organizations such as the Project Management Institute (Virginia Jobs Career Development, n.d.; National Association of Colleges and Employers, n.d.; Udo and Koppensteiner, 2004). The authors theorize that many competencies exist in multiple competency frameworks and are ripe for harmonizing activities. As competency frameworks are developed and refined, these would be described through the Domain, Subject, or Discipline identifiers. While the authors are not proffering a list of domains, subjects, or disciplines in this prototype, they are keenly aware that such a list should be developed before a taxonomy is implemented. There are domain, subject, or discipline lists that could serve as sources for this taxonomy such as the SUNY Empire State College's Global Learning Qualifications Framework (GLQF) or the Western Interstate Commission for Higher Education (WICHE) Interstate Passport. While these frameworks were informed through and align to similar works (e.g., the LEAP Essential Learning Outcomes developed by the Association of American Colleges and Universities), they are distinct.

Characters 4-7: Competency Identifier

The competency identifier consists of four alphanumeric digits that are specific to the assigned competency. Unique characters distinguish each knowledge, skill, or competency that exists within the same domain. These identifiers could be sequential numbers under the domain classification or randomly assigned alphanumeric characters provided there is not a hierarchical designation. Because the relationship between knowledge, skills, and competencies can be contextual, it would be difficult to maintain a numbering system that suggests a hierarchy.

Characters 8-10: Knowledge, Skills, and Competencies

This section of the code consists of three alphanumeric characters and reflects the knowledge, specialized skills, personal skills, and social skills as articulated in the Beta Credential Framework (Lumina Foundation, 2015a). The Beta Credential Framework adequately describes the nuanced nature of knowledge, skills, and attitudes that should exist in credentials. While it would be appropriate to identify hierarchies of knowledge and skills that form competencies, many existing frameworks make no such distinctions. Thus, the authors elected to distinguish between knowledge, skills, and competencies within a common code. This allows for the greatest flexibility while still creating a structure for articulating learning. The characters recommended are based on the Beta Credential Framework (Lumina Foundation, 2015a) recommendation and include:

- KNO – Knowledge – What a learner knows, understands and can demonstrate in terms of the body of facts, principles, theories, and practices related to broad general or specialized fields of study or work.
- SPE – Specialized Skill – Skills that are occupational and discipline-specific.
- PER – Personal Skill – Competencies required to act in an independent and responsible manner in various situations, to exercise judgment, demonstrate critical thinking and problem solving, reflect on one's own actions and on the actions of others, and to continue to develop his/her own competencies.
- SOC – Social Skill – An individual's ability to be aware of the behavior of others and of differing viewpoints, to communicate with others effectively, and to work effectively with people from diverse backgrounds and points of view.
- COM – Competency – A learnable, measurable, role-relevant, and behavior-based characteristic or capability.

Because many employers and educators use terms such as competencies, sub-competencies, knowledge, skills, abilities, attitude and social maturity interchangeably, the index eliminates the need to rework existing frameworks to fit a standard hierarchy by allowing constituents to simply identify what is being articulated. For instance, while one framework might consider a distinct skill a competency, another might capture this skill as a component of a sub-competency. These nuances do not need to be defined in the competency taxonomy. Using the proposed taxonomy, specific knowledge, skills, or competencies can be identified through various levels of granularity; thus framework creators can choose how to apply these to their unique initiatives.

Characters 11-12: Annual Rate of Decay

Neuropsychology research has shown that human memory fades with the passage of time (decay theory) or because of interfering succeeding events (interference theory) (Altmann and Grey, 2002). This has spurred many professional certification organizations, particularly those dealing with human health and safety, to assert that specific skills and competencies need to be reacquired or refreshed at specific time intervals. Furthermore, some technical fields suggest that technical skills should be refreshed regularly and based on contemporary technologies. Clearly, there are many reasons why

knowledge, skills, and competencies might decay. These include, but are not limited to, the following:

- Advances in the field/knowledge
- New technology
- Changes in professional licensure
- Changes in accepted or common practices
- Changes in physical attributes of the individual (for physical or specialized skills)

The authors are not suggesting that all knowledge, skills, and competencies decay; rather, we posit that characters that address this phenomenon would be necessary for a universally accepted taxonomy.

Characters 13-14: Level of Proficiency

This alphanumeric indicator within the taxonomy details the level of proficiency achieved. To avoid age cohort relationships, the authors sought a measure of proficiency that was both well-articulated and not associated with grade levels found in the educational system of the United States. For this reason, the authors recommend adopting the levels of proficiency identified in the Beta Credential Framework (Lumina Foundation, 2015a). The levels are as follows:

Level 1 Demonstrates the achievement of fundamental competencies to complete narrow and limited tasks within a highly structured field of study or work under direct supervision or guidance.

Level 2 Demonstrates the achievement of fundamental competencies to complete technical, routine tasks within a structured field of study or work largely subject to overall direction or guidance.

Level 3 Demonstrates competencies for processing well-defined technical tasks that are less structured and include non-routine tasks. These tasks have some degree of complexity, assigned within a comprehensive field of study or occupational activity subject to some change and largely subject to overall supervision or guidance.

Level 4 Demonstrates competencies for the processing of specialized and complex tasks within a comprehensive field of study or an occupational environment that is subject to change. This requires theoretical knowledge and practical skills to select appropriate principles and procedures and may involve overall supervision.

Level 5 Demonstrates advanced competencies for the processing of comprehensive tasks assigned within a complex and specialized field of study or occupational activity subject to change. This requires the ability to select and apply appropriate theoretical knowledge and practical skills to perform technical tasks in a broad range of contexts.

Level 6 Demonstrates mastery in the processing of comprehensive tasks and problems within subareas of a field of study or within a field of occupational activity characterized by a high degree of complexity and by frequent changes. This requires a high degree of theoretical knowledge and practical skills.

Level 7 Demonstrates competencies for the processing of new and complex professional tasks and problem settings within a scientific subject or an occupational field characterized by frequent and unpredictable changes. This requires the need to elucidate the major theories and the application of advanced specialized knowledge, research methods and approaches in various contexts.

Level 8 Demonstrates competencies for obtaining research findings in a scientific subject or for the development of innovative solutions and procedures in highly complex and novel problem situations within a field of occupational activity. This requires a capacity for a wide range of strategic and scientific thinking and creative action.

The authors believe these eight levels adequately describe the levels of proficiency necessary for workforce development and talent management. However, while not intended to do so, the availability of two alphanumeric characters would allow framework developers to codify additional levels, such as mastery or grade cohort.

Character 15: Visual Break

A visual break character is designated to clearly differentiate the competency information (indicated by alphanumeric characters to the left of the break) from the assessment information captured (as indicated by alphanumeric characters to the right of the break).

Characters 16-23: Date of Validation

These eight characters represent the date, using Gregorian calendar notation, on which the proficiency was assessed by the validating agency. The data format follows a *yyyymmdd* date schema. The authors assume that postsecondary institutions will likely use the last date of an academic term as the date of validation rather than individual assessment dates within a course.

Character 24: Assessment

This character details the type of assessment used to determine the proficiency achieved by the learner. The authors used the "assessmentmethod" variable detailed in the Credential Transparency Descriptive Language (CTDL) (Credential Engine, 2018, April 27). In the CTDL there are three assessment types identified:

- assessMethod:Artifact
- assessMethod:Exam
- assessMethod:Performance

These three methods represent the majority of assessments that would measure and validate proficiency of a knowledge, skill, or competency.

Characters 25-33: Validating Agency

A key component of this proposed taxonomy is the validating agency. The validating agency — whether a postsecondary institution which itself is validated by accreditors, the military which has established rigorous assessments of performance for knowledge, skills, and competencies, or employers that validate workplace learning through articulated competency sets and talent management systems — must be articulated in the taxonomy. This gives users key information on the origins of the individual's learning achievement. Because there is no central repository for all institutions, organizations, and employers, this portion of the code was difficult to detail. The authors found no system that considers all of these entities as similar or equal with a unique identifier that is discrete but not U.S.-centric (cf. Employer Identification Numbers maintained by the IRS, Institution Codes maintained by the Department of Education, etc.). For this reason, the authors suggest the use of Dun & Bradstreet D-U-N-S Numbers as these are both international and non-sector specific (Dun & Bradstreet, n.d.). This nine-digit number is required of all entities that do business with the federal government. Because these numbers are assigned without a fee, it would appear to be a strong solution for many of the institutions and employers likely to verify knowledge, skills, and competencies.

Alternative Taxonomy Sections Considered but Eliminated:

Stakeholder discussions presented many concepts for inclusion in a competency taxonomy. However, while beneficial in certain situations, these alternatives were excluded after careful consideration deemed them less than critical for adoption.

Multi-level indexing
Many competency frameworks and models assume that competencies consist of skills, knowledge, and attitudes. Furthermore, several reviewed frameworks suggested sub-competencies leading to greater competencies. While it first seemed logical to directly represent a hierarchical structure in the coding schema, a more detailed examination revealed that often items which were classified as competencies were actually skills, and vice versa. Furthermore, some organizations had identical competencies derived from different skills. In order to accommodate these diverse scenarios — as the index is designed to be inclusive — the hierarchical indexing capability was eliminated. However, it should be noted that using the levels of proficiency for knowledge, skills, and competencies could imply hierarchical relationships.

Identification of closed and open standards
Several organizations have developed proprietary standards and competency models. Furthermore, the authors recognize that in some cases postsecondary faculty have developed proprietary competencies and aim to protect these as intellectual property. To address this issue, several discussions were facilitated about the importance of providing the capability of proprietary competency frameworks and clearly identifying proprietary information. For instance, the ability to include licensing information (e.g., Creative Commons attribution) was discussed, but ultimately eliminated as a component of the index. This decision was made because most competencies are redundant with or similar to existing open competencies found across sectors and on both the competency supply (e.g., education) and demand (e.g., employer) sides.

Identification of human-created or machine-created competencies
Due to increasing quantities of machine-generated competencies and the potential for error in classifying such competencies, an identification of whether a code was generated through a human process or generated using technology is suggested. This identifier could simply be a binary value, for instance, with a zero denoting that the code was developed using a shared governance process and a one indicating that the competency classification was machine-generated. The benefit of including such an indicator is that once identified, steps could be taken to identify and review machine-generated competencies (such as those derived from online job postings). Ultimately it was determined that machine- and human-developed competencies required human validation at some point, and we elected to eliminate specific indications of how the knowledge, skill, or competency was sourced.

Identification of country code
Because competency frameworks exist globally, there were several discussions regarding the identification of the country in which the frameworks were developed. For instance, the Slovakian government is developing competency frameworks for public sector positions. Furthermore, universities and other education providers could more easily target country-specific competencies by querying for a specific country code. It was suggested that one of the existing international standard country codes (two digits or three digits) could be used. However, this was eliminated from the proposed classification index because competencies are consistent across borders and descriptions in specific languages are not included.

Competency description
Narrative competency descriptors are often unique to the domain or subject matter. Rather than describing the competency in the taxonomy, the authors elected to maintain simplicity by suggesting that competencies can exist in different domains and have domain-specific language without limiting the usefulness of the taxonomy. For example, communication competencies in healthcare may be very similar to communication competencies in customer service. The authors feel that these competencies

can be harmonized and coded similarly, noting that professionals from each discipline may add their own discipline-specific language to articulate the knowledge, skills, or competencies of their constituents. Furthermore, including a text-based competency description would require selection of a specific language to articulate the description. By eliminating the description from the index, narrative descriptions can be managed by framework owners in their preferred language.

Integration with Technical Standards, Specifications, and Models

The authors of this document took great care to adhere to and reuse properties from existing technical competency models, including technical specifications developed by the IMS Global Learning Consortium (IMS Global) known as the Competency and Academic Standards Exchange (CASE) standards. Furthermore, the OpenSALT competency-management tool, developed by the Public Consulting Group using the CASE standard, was reviewed for compatibility. Finally, Credential Engine and the Credential Transparency Description Language (CTDL) were examined to ensure compatibility. By adopting properties from existing technical frameworks, the authors sought to make this new taxonomy more relevant to those using existing competency models and frameworks. Further, specific variables informed through such frameworks could support interoperability and translations from various frameworks into common frameworks used broadly within the education and talent development ecosystem.

Additionally, system specifications for existing learning management systems, student information systems, and human resource management systems were reviewed. All of the systems examined included data fields that could be populated using the proposed taxonomy. More advanced integrations could allow these fields to be linked directly to specific data.

Implementation Recommendations

The authors considered numerous implementation approaches, business models, and management infrastructure. This analysis resulted in a recommendation to facilitate discussions with entities such as the American National Standards Institute (ANSI), the International Organization for Standardization (ISO), or the Deutsches Institut für Normung e.V. (DIN). Doing so could accelerate the adoption of the framework, particularly internationally. Alternately, an international organization such as the United Nations Educational, Scientific and Cultural Organization (UNESCO) could be approached regarding the endorsement and maintenance of the index. Finally, because the taxonomy lends itself to becoming an open standard, such an approach could ensure more rapid adoption. This would allow all necessary stakeholders to have immediate access to the index, while preventing 'capture' by a single vendor or organization. Since the taxonomy can be used by varying types of agencies, open standards would allow for the diverse population of users to look at innovative ways that the taxonomy can be applied and enhanced. To facilitate the taxonomy management using an open standard approach, open standard management methods such as those used by DIGISTAN could be investigated.

Next Steps

The authors are keenly aware that the development, piloting, and future use of a taxonomy that articulates learning requires a significant amount of work and collaboration across sectors. This paper serves to introduce the concept of a learning competency taxonomy and assumes that further development and collaboration will be necessary before any level of adoption. To that end, the authors suggest the following steps to refine this idea and create an environment where widespread adoption may occur.

- Identify a list of knowledge, skills, and competencies that contain domains, subjects, or disciplines and develop an initial list for use in the taxonomy (Characters 1-3), allowing for a proof-of-concept.
- Develop guidelines and workflows for the mapping of competencies to the index. Target specific professional organizations to formulate and test the process.
- Work with system vendors to develop best practices for applying the competency classification index values to specific systems.
- Apply the taxonomy to existing competency registries.
- Leverage artificial intelligence processes to index written statements and to harmonize/translate knowledge, skills, and competencies from disparate domains, subjects, and disciplines.
- Develop or work with existing developers to create recommender and look-up systems for integration with learning and employment systems.
- Develop training programs for curriculum developers, human resource professionals, and learners.

Conclusion

As articulated earlier in this document, workforce and education leaders have all observed the disconnects among educators, employers, and learners. Siloed systems, a lack of resources, and opaque processes have pitted each group against the others in public discourse. Are educators preparing students for the world of work? Are employers providing clear signals regarding workforce needs? Do learners have the knowledge, skills, and competencies to be successful workers and advanced degree seekers? Ask anyone from each respective group and you will receive a resounding "yes," but ask anyone outside one of these groups, and the answer is almost unequivocally "no." The authors of this paper and developers of the taxonomy prototype contained herein believe that each question can and should be answered affirmatively, no matter the perspective. These issues — often simplified to terms such as the skills gap, credential inflation, and lack of learner agency — boil down to a much simpler problem: the absence of a common language for learning experiences that exist within and outside formal educational settings.

Creating a common language is no small task. We see that U.S. postsecondary education has defaulted to the academic credit hour due to the inability to identify another unit of measurement for knowledge and performance. The taxonomy prototype proposed in this paper assumes that educators, employers, and learners have a vested interest in a better unit of measure for learning experiences. Further, it presupposes that technology-enabled collaboration will support stakeholders in the development and adoption of such a taxonomy. Yet technology cannot, by itself, solve such complex issues. Educators,

employers, and learners must collaborate on the concepts and ideas offered here. Harmonizing complex concepts such as knowledge, skills, and competencies will be difficult but rewarding with widespread adoption.

While there have been recent developments in capturing, coding and storing competency information with the ultimate goal of using technology standards to achieve system-level interoperability of the data, such efforts largely revolve around distinct, competency-aware organizations. These efforts provide valuable paths for future development, yet most of today's competency environment is based on data and information stored in siloed and restricted environments. To ensure equitable participation, organizations ranging from small- to medium-sized businesses to the nearly 5,000 formally recognized institutions of learning must have access to an open and accessible taxonomy. For instance, there are nearly 6 million firms with employees in the United States, and nearly 90 percent of these employ 20 people or fewer (SBE, 2018). A universal competency index that is not tied to specific platforms or vendors would allow these small organizations to gain value through the application of true competency-based hiring practices. Similarly, among the nearly 5,000 postsecondary degree-granting institutions (NCES, 2018), the transition to competency-based education will be gradual. By forcing only some institutions to make significant investments in technology and training, opportunities to capture competency achievement would remain elusive for most others. Ensuring universal access to an open indexing capability without the need for massive technology investments would allow the "long tail," consisting of the majority of students and employees, to benefit.

As the workforce becomes increasingly global, a taxonomy of competencies could ensure equitable treatment of the labor pool, something that is challenging due to disparate educational systems and credentialing. While the impact of an increasingly global labor force may not seem immediately obvious, in 2017, the foreign-born labor force within the U.S. reached 17 percent. However, data show that this portion of the labor force has significantly less educational attainment, earns less than a U.S.-born employee, and is more likely to be employed in the service sector (BLS, 2018). Specialists could work with such employees, performing prior-learning and experience assessment to determine which competencies have been achieved — ultimately providing more equitable access to employment. Furthermore, while no longer tracked effectively, it is estimated that between 2.2 million and 6.8 million U.S. citizens live abroad (Costanzo & von Koppenfels, 2013). Of these, those who had attained education in the U.S. would need to rely on work history and the obscure credit-hour-based transcript (which is often misunderstood outside the U.S.) for career attainment.

Change is difficult, particularly when it spans organizations, sectors, and nations. However, the development of similar schemas has led to the ability to capture, identify, and share information. Examples include the International Classification of Diseases (ICD), vehicle identification numbers (VIN), or retail stock keeping units (SKU). Similar to these, it is envisioned that a competency classification index could be developed and applied at universal, sector-specific, or organization-/institution-specific levels. The continuous testing, refinement, and adoption of competency taxonomies could help improve consistency when articulating learning. A competency classification index will help foster a shared understanding and facilitate the exchange of competency information within organizations, between organizations, between industry sectors, and even between education and industry. And above all else, such an index would create an opportunity for stakeholders to discuss the authentic assessment of learning, knowledge, and performance, which can lead to greater equity and access to both education and career opportunities.

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