On Alternative Measures for Dynamic Large-Scale Online Learning

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Abstract

The purpose of this thesis project is to propose a theoretical construct to configure forward-looking alternative measures for dynamic large-scale online learning. This unifying construct could function as a platform and pedagogy agnostic learning object situated architecture system, which measures multidirectional and multidimensional learning interactivity between the learner, the course content, and larger sociocultural system dynamics of multiple inputs and outputs. Current centralized asynchronous time-based instructional metrics quantified by credit hours of educational attainment and targeted performance outcomes demonstrate transparency and flexibility constraints, which are characteristic of closed systems. Whereas, the proposed mutually reinforcing multi-inputs and outputs for impact (MIOI) capture mechanism and its learning object feature could improve *transparency* and *flexibility* efficiencies in large-scale online learning settings. Theoretically, the proposed construct could reconfigure inefficient antecedent bundles of time-based instruction into measurable decentralized synchronous large-scale learning configurations. This open system approach of dynamic multiple inputs and outputs can be further optimized by video and MOOC ecosystem technologies. As such, the proposed MIOI capture mechanism construct could sequence the multiplicity of configurative unit operations into actionable online learning at many scales of efficiency to redefine what it means to be educated in the Digital Age. Therefore, the stated theoretical construct to establish alternative measures for dynamic large-scale online learning has been proposed to advance future large-scale digital learning processes and efficiencies.

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Chapter 1 Introduction

Education has been regarded as central to the welfare of human civilization since the ancients. A quotation widely ascribed to Socrates affirms that, "education is the kindling of a flame, not the filling of a vessel." Historically, education has largely been held as a fundamental human right, key indicator of knowledge and skills diffusion, and driving beacon of human progress (United Nations, 1948; WEF, 2014). Authentic human development is described as, "a process of expanding the real freedoms that people enjoy" (Sen, 1999, p. 3). Real freedoms are effectuated by equal access to educational opportunities that develop human capabilities and produce a valued quality of life (Watkins, 2012). Currently, the education industry is experiencing unprecedented disruptions as a result of technological progress and socioeconomic forces. As such, deep-rooted educational inefficiencies are at issue. The institutional one-size-fits-all factory model of education is incompatible with the increasingly personalized networked processes of the Digital Age (Mitra, 2013). Technological progress, the rising cost structure of brick-and-mortar higher education, crushing student debt, and rapidly increasing demand for education that exceeds its supply are the source of structural shifts in the global education industry (Reich, 2015b). Increasing technological convergence and the proliferation of large-scale educational technology (Ed Tech) platforms has had a marked impact on a growing percentage of learners in the developed and developing world (WEF, 2014; Moe et al., 2015). Transformative digital innovation has initiated a discussion on how institutions of higher learning can best deliver centralized asynchronous instructivist pedagogies worldwide. However, informed educators understand that the superficial overlay of outmoded Fordist educational models of the Industrial Age onto programmatic large-scale Ed Tech platforms, such as massive open online courses (MOOCs) distributed by MOOC providers, will not satisfy the growing global demand for high quality education in a meaningful way. Therefore,

the effective framing of sustainable access to educational equity and subsequent human development across diverse populations must acknowledge that, "students need to learn how to learn and they have to learn in particular how to learn online" (Dirks & Hennessy, 2015).

With this in mind, it is imperative that global stakeholders ask how instructional design and measured processes can be better shaped for dynamic large-scale online learning that aligns to job acquisition, economic mobility, and authentic human development. These questions are fundamental to a functional future as, "education is both a compelling indicator and powerful instrument of human progress" (WEF, 2014, p. 4). Institutions of higher learning are fiscally and geopolitically aware that, "we're all going to have to deal with that issue" (Dirks & Hennessy, 2015). In that government educational regulations and instruments for control, monitoring, and enforcement continue to fail to deliver learning outcomes as a universal human right for effectual human development, education policy that employs intelligent accountability and alternative measures for dynamic large-scale online learning are needed (O'Neill, 2002b; dLRN, 2015; United Nations, 1948; O'Neill, 2002a). Dr. Barbara Means, director of the Center for Technology in Learning at SRI International states that, "we are at a crisis point" and reorientation is requisite (dLRN, 2015). The general consensus of compulsory student performance assessment as a trusted proxy indicator of learning is that, "the measurement fad has spun out of control...education is experiencing its own version of measurement fatigue...measurement cannot go away, but it needs to be scaled back and allowed to mature" (Wachter, 2016). Gardner Campbell, vice provost for learning innovation and student success at Virginia Commonwealth University argues that learning is difficult to measure primarily due to the fact that the education industry is, "asking the wrong set of questions" about what the word measure means and, "that a really interesting kind of analytics should reveal to the learner even more possibilities for their own connected learning. The

analytics shouldn't simply be a kind of a diagnosis of what's happening now, but analytics at their best can be a doorway that suggests what else is possible" (Educause, 2015). Hence, the proposed formulation of alternative measures for dynamic large-scale online learning has given careful attention to the commentary that, "when a measure becomes a target, it ceases to be a good measure" (Strathern, 1997, p. 308).

Traditional instructional design models, learning theories, and educational technologies target and assess broad features of siloed education. However, meaningful metrics of learning that transfer to authentic socioeconomic productivity remain elusive to date. Therefore, the question of how to effectively deliver education in the Digital Age is the, "new front in a century old war, between Thorndike and Dewey, between instructionism and constructivism. Thorndike was an advocate of an education science driven by objective measurement; Dewey was an advocate of making schools look like life, even if the results were harder to measure" (Reich, 2012). Current Thorndike-leaning metrological practices framed by centralized asynchronous large-scale offline and online instructivist models promote structural constraints, which fragment instruction and hinder the efficient capture of authentic learning processes. Whereas, the proposed Dewey-inspired future alternative measures within the context of a decentralized synchronous construct could digitally configure *transparent* and *flexible* learning experiences optimized by video and MOOC ecosystem technologies (Reich, 2012; Silva et al., 2015; Ho et al., 2015; Guo et al., 2014). Throughout the history of institutionalized education, instructivists have claimed, "that we cannot learn about underlying processes by aggregating across methods. However, the flexibility of the formation of functional systems in response to real-world tasks appears to be an important cognitive phenomenon in its own right" (Hutchins, 1996, p. 289). In fact, the dysfunction that currently exists in education is considered a systems related, "pragmatism problem, which requires

research that's tied to the problem of identifying multiple measures of value of education" (dLRN, 2015). Thus, a bricoleur systems thinking approach is needed to substantiate learning as, "the propagation of some kinds of organization from one part of a complex system to another" (Hutchins, 1996, p. 290). The proposed theoretical construct to configure alternative measures for dynamic large-scale online learning demonstrates that, "to attain the multiple, one must have a method that effectively constructs it" (Deleuze & Guattari, 1987, p. 22). Therefore, said unifying construct could serve to reestablish and advance education as the great equalizer of the world's 7.3 billion potential culturally constituted learners (United Nations, 2015b; Meadows, 2008).

As such, educational equity and applied human capital resource allocation could be best achieved by means of platform and pedagogy agnostic learning object situated architecture system, which configures multidirectional and multidimensional learning interactivity between the learner, the course content, and larger sociocultural system dynamics of multiple inputs and outputs. The proposed mutually reinforcing multi-inputs and outputs for impact (MIOI) capture mechanism construct could establish future proxy indicators of learning that qualitatively quantify, equalize, and optimize the digitally mediated interplay and power dynamics between culturally constituted learners (Learners). This proposed theoretical construct defines Learners as students, teachers, educational institutions, researchers, enterprise, international governmental organizations (IGOs), international non-governmental organizations (INGOs), non-governmental organizations (NGOs), nonprofit organizations (NPOs), and private foundations (Alexander et al., 2009; Meadows, 2008; Crosslin & Dellinger, 2015). For purposes of standardization, the exploratory research design of said proposed construct has been framed through the bricoleur systems thinking lens of generalized dynamic inputs and outputs optimized by video and MOOC ecosystem technologies (Meadows, 2008; OECD, 2014; The World Bank, 2013; Ho et al., 2015; Guo et al., 2014). From this

methodology, each MIOI capture mechanism learning object, in theory, could reconfigure dynamic inputs and outputs into measurable learning configurations situated by, "culturally constituted human activity" (Hutchins, 1996, p. xiii). Thus, the proposed unifying construct to configure future alternative measures for dynamic large-scale online learning could be theoretically understood as a fundamentally socially distributed cultural process that yields infinite measures of value, rather than finite products of institutionalized education (Bogost, 2006; Alexander et al., 2009; Carse, 1986; Illich, 1971).

Chapter 2 Thesis Goal

The thesis goal is to propose a theoretical construct to measure learning efficiencies in large-scale online settings. This unifying MIOI capture mechanism construct could function as a platform and pedagogy agnostic learning object situated architecture system, which measures interactional learning multiplicities between the Learner, the course content, and larger system dynamics of multiple inputs and outputs. A bricoleur systems thinking approach optimized by video and MOOC ecosystem technologies is employed in the proposed formulation of alternative measures for dynamic large-scale online learning.

An exploratory literature review of the origins, applications, and effectiveness of current large-scale instructional metrics demonstrates structural inefficiencies in education systems. Current centralized asynchronous time-metered instruction quantified by credit hours of educational attainment and targeted performance outcomes constrain *transparency* and *flexibility*. Whereas, the proposed mutually reinforcing MIOI capture mechanism construct and its learning object feature could sequence the multiplicity of configurative unit operations to improve *transparency* and *flexibility* in large-scale online settings. Thus, the proposed unifying theoretical construct to configure alternative measures for dynamic large-scale online learning could advance future large-scale digital learning processes and efficiencies.

Chapter 3 Research Approach

Question 1 What are the origins of measures for centralized asynchronous large-scale instruction? Why was time-based large-scale instruction instituted?

Prior to the advent of digital media and the Internet, referred to as the Digital Age, past measures for dynamic large-scale online learning did not exist (Isaacson, 2014). As such, past measures of large-scale instruction, which encompassed the assessment of writing, examining, and grading were metered by, "blocks of instruction called "counts" - ten weeks of study, five days a week" (Silva et al., 2015, pp. 7-8). Thus, educational attainment and performance quantified as 'human accounting' under the rubric of 'assessment' was valued and targeted largely for the development of a workforce capable of meeting the production demands of the Industrial Age (Strathern, 1997; Mitra, 2013). Accordingly, a literature review was conducted to determine the origins of current measures for large-scale online instruction.

Question 2 What impact have time-based instructional metrics had on centralized asynchronous large-scale online instruction? Why are decentralized synchronous alternative measures for dynamic large-scale online learning needed?

Current measures of large-scale online instruction have yet to be fully defined or integrated as a result of constraints imposed by the systemwide application of time-based instructional metrics, also referred to as the Carnegie Unit or credit hour. The bundling of time-based large-scale instruction under the guise of educational attainment and targeted performance, has functioned to centralize, codify, and constrain quality measures of learning that offer *transparency* and *flexibility*. Hence, centralized asynchronous large-scale online instruction has not been effectively adopted by education systems (Silva et al., 2015; Shrader & Mock, 2014). Thus, a

literature review of the applications and effectiveness of current large-scale online instructional measures has been conducted to determine the need for proposing a theoretical construct to support the configuration of future alternative measures for dynamic large-scale online learning.

Question 3 How might a unifying theoretical construct to configure forward-looking alternative measures for dynamic large-scale online learning be proposed? How can antecedent time-based instructional measures inform future proxy indicators of learning?

Technological progress, widening patterns of educational inequality, and misaligned human capital resource allocation necessitate education reform that fosters, "new educational models that are, as Education Secretary Arne Duncan has described, 'defined by learning outcomes, not 'seat-time' requirements'" (Silva et al., 2015, pp. 9-10). As such, the proposed unifying theoretical construct could function as a platform and pedagogy agnostic learning object situated architecture system by which to measure learning interactivity between the Learner, the course content, and larger sociocultural system dynamics of multiple inputs and outputs (Crosslin & Dellinger, 2015; Alexander et al., 2009; Hutchins, 1996; Meadows, 2008). The proposed construct could reconfigure inefficient antecedent bundles of time-based large-scale instruction through a learning object enabled MIOI capture mechanism optimized by video and MOOC ecosystem technologies to improve *transparency* and *flexibility* efficiencies (Silva et al., 2015; Alexander et al., 2009; Bogost, 2006; Ho et al., 2015; Guo et al., 2014).

Chapter 4 The Origins of Centralized Asynchronous Time-Based Large Scale Instructional Measures Explained

The University of Bologna (A.D. 1088), arguably the oldest continuously-operating university in the world is considered the birthplace of today's almost one thousand year old education industry (UC Berkeley Events, 2014). Prior to education officially being declared a human right by the United Nations in 1948, the Church mandated free education for the poor in 1179. The reformation and subsequent government intervention of education during Europe's High and Late Middle Ages, marked a period of increasing standardization of instructional design and learning management that influenced modern organized education worldwide (United Nations, 1948; Orme, 2006).

Organized education, the dawn of measured learning, dates back to, "the pedagogic revolution in the second half of the 18th century that culminated in new ways by which to examine university students" (Strathern, 1997, p. 305). Metrological practices referred to as 'human accounting' took shape under the rubric of 'assessment' in universities throughout Europe. The assessment of student written and oral work was soon overshadowed by the concept of standardized written examinations as a heightened form of assessment. The University of Cambridge Local Examinations Syndicate introduced written examinations as impartial instruments of measured learning, "for making levels of attainment visible" (Strathern, 1997, p. 307). Oral testing with the agency of written examinations was introduced by the English in the 1760's as a, "vehicle for the formal testing of knowledge and ability...which could sustain teachers by being able to 'at once test and attest the soundness of their work'" (Strathern, 1997, p. 307). In 1792, the quest to establish the proper measure of student performance and ability by way of numerically marked answers consummated, "the idea of an examination as the formal testing of

human activity joined with quantification (that is, a numerical summary of attainment) and with writing, which meant that results were permanently available for inspection." (Strathern, 1997, p. 307).

Quantifiable examination techniques in the education industry ushered in the concepts of accountability and 'human accounting' in particular, which were subsequently adopted by commerce oriented sectors and industries. When defining sectors and industries as cultures within a diverse system, each culture inextricably operates to extend, alter, and loop upon the other to effectuate some measure of improvement-centered value transmission. The governmental colonization of education, most notably by the British Empire, who sought to increase the value of education by targeting it as a means to produce a workforce capable of servicing the production processes of the Industrial Age, serves as a striking example of cultural replication. Education researcher and entrepreneur, Sugata Mitra, maintains that the one-size-fits-all Victorian factory model of education was invented to, "produce the people who would then become parts of the bureaucratic administrative machine...they must be so identical that you could pick one up from New Zealand and ship them to Canada and he would be instantly functional" (Strathern, 1997; Mitra, 2013).

Blended and applied measures from three separate 18th century practices; writing, examining, and grading claim that, "with measurement came a new morality of attainment. If human performance could be measured, then targets could be set and aimed for...This new morality was epitomized in the concept of improvement...measuring the improvement leads to improving the measures" (Strathern, 1997, pp. 307-308). Further measured standards from which current measures of learning are derived include, "blocks of instruction called "counts" - ten weeks of study, five days a week" (Silva et al., 2015, pp. 7-8). However, the ardent notion of 'improvement'

under the rubric of 'assessment' and 'human accounting' was relatively ineffective in its ability to extend, alter, and loop learning outcomes to broaden the scope of measurement and improve standards of performance.

The global promise of generative cultural replication within a diverse system has been and continues to be perverted by measured value silos that operate as targets across sectors and industries, especially the education industry. Therefore, with past and current measures in mind, Goodhart's law argues that when the expectation of performance is put upon a measure in the form of a target, said measure's discriminator is compromised and its measurable value is thereby diluted (Strathern, 1997).

Chapter 5 Centralized Asynchronous Time-Based Large-Scale Online Instructional Constraints and the Need for a Formulation of Decentralized Synchronous Future Measures Explained

Current standardized *explicit* time-based instructional metrics, learning management system (LMS) tools, and *implicit in* partial indicators of educational attainment, performance, and improvement are under increasing scrutiny from educational reformers. The argument of targeted time-based instruction as an effective measure of education has been challenged (Silva et al., 2015; Dahlstrom, 2014; Brown et al., 2015; Watkins, 2012; Strathern, 1997). Critics argue that the bundling of compulsory education impedes authentic learning, "by making instructional time the principle institutional marker of student progress toward diplomas and degrees" **(**Silva et al., 2015, pp. 13-14). Measures in practice are traditionally fragmented into what can be defined as *explicit* and *implicit* in standardization. Accordingly, standardized *explicit* measures are defined as measured conformity calculated by the weight of endogenous circumstances, whereas standardized *implicit in* measures are defined as partial metrics determined by the weight of exogenous circumstances. Therefore, deep-rooted structural inefficiencies and derivative data constraints that negatively effect systemized *explicit* and *implicit in* measures are by nature, a complex systems problem (Watkins, 2012; Meadows, 2008). Skewed input and output to outcome measures of educational attainment, performance, and improvement present an opaque representation of educational throughput and socioeconomic dispersion such that, "arguably more serious than these built-in data problems is the question of what is being measured" (Watkins, 2012, p. 4).

5.1 Standardized *Explicit* Measures

Education in the late nineteenth to early twentieth centuries was a nascent industry in need of a common proxy indicator of instruction, especially in higher education. Clearly defined standard measures of instruction were first introduced into the undeveloped American education system as a means to perfect input characteristics that distinguish high school from college levels of instruction. Thus, "the Carnegie Unit, also known as the credit hour, became the basic unit of measure both for determining students' readiness for college and their progress through an acceptable program of study" (Silva et al., 2015, p. 3). Regarded as an ingeniously crafted example of educational reform, the Carnegie pension system's enterprising reinvention of late eighteenth to mid nineteenth century education into the credit hour, a common metric and currency, serves as the foundation of current standardized *explicit* time-based instructional measures and today's estimated $7 trillion education Industry (Silva et al., 2015; WEF, 2014). The Carnegie Unit mandated that college admission requirements were defined in *explicit* terms to counteract administrative and educational inefficiencies and assure, "Academic and Industrial Efficiency" (Silva et al., 2015, p. 8).

The standardization of *explicit* time-based educational measures, which function to meter instructional time, perfect 'human accounting,' and monetize education, subsequently enabled the rapid proliferation of the industrial education complex, worldwide. High school and higher education accreditation are generally premised on a Carnegie Unit derived 120 credit hour metric. A traditional four-year high school diploma program with a twenty-four-week academic year requires approximately seven credits annually at one credit per course, which calculates to one hour of *explicit* time-based instruction per subject course on a Monday through Friday weekly basis. Whereas, standard four-year higher education degree programs are measured with a fifteen

week by fifteen credit hour metric per semester, which are calculated at three hours of *explicit* time-based instruction per five three-credit subject courses for each two semester academic year (Silva et al., 2015). In terms of 'human accounting,' the production of scalable performance outcomes, and commodified monetization of organized education, the Carnegie Unit centralized and codified, "academic transactions among students, faculty, and administrators...as well as eligibility for billions of dollars of federal financial aid" (Silva et al., 2015, p. 9).

Learning management system (LMS) tools largely operate to analytically perfect and technologically extend *explicit* time-based targeted instructional indicators of educational attainment, performance, and improvement within Carnegie Unit derived endogenous circumstances (Dahlstrom, 2014; Brown et al., 2015; Strathern, 1997; Silva et al., 2015). In general, LMSs have been widely adopted to enable the administration of *explicit* time-based instruction. Instructivist-centric tools that store, manage, and distribute *explicit* time-based content provide instructional efficiencies. However, despite a 99% adoption rate in higher education alone, LMSs have been less successful, "in enabling learning itself" (Brown et al., 2015, p. 2).

Learning management systems further extend *explicit* time-based instruction by way of automated learning objects, which are traditionally defined as “any digital resource that can be reused to mediate learning” (Metros & Bennett, 2002, p. 2). Current learning objects are targeted for *explicit* instructional attainment, performance, and improvement outcomes situated within a narrow system of tagged metadata, rather than larger sociocultural system dynamics of interactive inputs and outputs. Learning object attributes such as portability, accessibility, durability and interoperability are inextricably predicated upon metadata that is neither transparent nor flexible. Hence, exacting standards and specifications, such as the Sharable Content Object Reference Model (SCORM) that are used to package and load learning objects into LMSs, serve to further

perfect the delivery of misaligned homogeneous time-based instructional design (Metros & Bennett, 2002).

5.2 Standardized *Implicit In* Measures

Given the fact that *explicit* time-based Carnegie Unit derived instructional metrics are practiced globally in varying degrees, standardized *implicit in* partial indicators targeted for educational attainment, performance, and improvement outcomes are structurally influenced by the weight of endogenous circumstances, while nevertheless being significantly determined by the weight of exogenous circumstances (Silva et al., 2015; Watkins, 2012). Thus, current standardized *implicit in* partial indicators that quantify the dispersion of education and human development outcomes across centralized education systems are principally monitored, reported, and administered by the United Nations Educational, Scientific and Cultural Organization (UNESCO), the Organisation for Economic Co-operation and Development (OECD), The World Bank, United Nations Development Programme (UNDP), and World Economic Forum (WEF). Standardized *implicit in* targeted partial indicator data sets are sourced from the UNESCO Institute for Statistics (UIS), OECD.stat database, World Bank Open Data, UNdata, and Barro-Lee Educational Attainment Dataset and used to inform The EFA Global Monitoring Report, Deprivation and Marginalization in Education (DME) indicator, OECD Indicators of Education Systems (INES), Systems Approach for Better Education Results (SABER), Education Index of the Human Development Index (HDI), Inequality-adjusted Human Development Index (IHDI), Human Capital Index (HCI), and Gini Coefficients (UNESCO Institute for Statistics, 2014; OECD, 2015; The World Bank Group, 2016; UNdata, 2016; WEF, 2015b; Barro & Lee, 2013).

Educational attainment has traditionally functioned as an underlying component of educational proxy indicators. Attainment indicators are directly correlated to educational

qualitative efficiency. Educational attainment is classified as internal and external attainment. Qualitative efficiencies are further defined in terms of selection functions; internal accreditation and an external cost versus benefit to society formulation (Scheerens, 2011). Standardized *implicit in* partial indicators are heavily weighted by the mapped configuration of educational attainment distribution patterns across populations. Although *Implicit in* educational attainment measures are often perceived as closely associated to educational performance and improvement, disproportionate inherited disadvantages influence learning outcome inefficiencies. The Barro and Lee educational attainment dataset provides *Implicit in* partial measures disaggregated by sex, age, and mean years of time-based instruction across 147 countries. Other disaggregated variables of educational attainment can include wealth and gender. The United Nations Human Development Index (HDI), Inequality-adjusted Human Development Index (IHDI), and Gini coefficients use the Barro and Lee educational attainment dataset to measure educational inequality (Barro & Lee, 2013). The Deprivation and Marginalization in Education (DME) indicator also measures for departures from education equity, albeit from, "the incremental layers of disadvantage created by overlapping characteristics" (Watkins, 2012, p. 3).

The UNESCO led Learning Metrics Task Force (LMTF) has endeavored to realign the global measures focus from assessment to applied assessment and learning. In coordination with Millennium Development Goals (MDGs) and in response to educational inequities identified in UNESCO's EFA Global Monitoring Report compiled by UIS, the UNESCO Institute for Statistics and the Center for Universal Education at Brookings (CUE) Learning Metrics Task Force have recommended that learning indicators be identified to track and facilitate interventions for perfecting assessment systems for qualitatively quantifiable learning outcomes across all countries. Current indicators and yet to be developed indicators seek to measure *explicit* and

implicit in learning opportunities that provide equal access to educational opportunities and expand real freedoms for human development (UNESCO, 2013; The Brookings Institution, 2016; Sen, 1999).

OECD Indicators of Education Systems (INES) organizing framework differentiates education systems nationwide on three differentiated levels. INES has taken a systems approach methodology to perfecting performance measures of centralized education systems on a national level by recognizing that a system can only be partially understood by acknowledging its component parts. Thus the INES organizing framework has been designed to qualitatively quantify the interplay between inputs, outputs, and procedurally durable time tested centralized asynchronous instructional outcomes. Understanding that educational attainment and other inputs function as fundamental components of educational proxy indicators, INES has been better able to configure its indicator framework to target output derived learning outcomes on multiple levels that are more granular. A time perspective is identified as a dynamic feature as well. The multidimensional aspect of the INES organizing framework serves to extend its functionality and usefulness. Although the INES framework takes the position that education systems nationwide function in isolated instructional silos, said framework has not identified larger sociocultural system dynamics that leverage flows of information into infinite input and output derived outcomes (OECD, 2014; Meadows, 2008).

The World Bank SABER (Systems Approach for Better Education Results) initiative for the collection and analysis of system-wide education policy information is mandated to qualitatively quantify educational input and outcome measures in terms of, "a more balanced analysis of the whole education system, aimed at identifying the binding constraints to learning, wherever they are" (The World Bank, 2013, p. 4). In response to unmet UN Millennium

Development Goals (MDGs) first established in 2000, SABER has been designed as a MDG delivery system for the alignment of system-wide learning outcomes to socioeconomic growth, poverty reduction, and human development. SABER's focus is to narrow the gap between educational inputs and actionable learning outcomes in current centralized education systems. Quality is a primary input feature of SABER results chain measures; institutional quality, policy quality, and delivery of quality education outcomes by means of more granular policy implementation. The SABER database highlights three types of system-wide education policy information, "analytical, descriptive, and evaluative" (The World Bank, 2013, p. 15). The quality input feature is further integrated into SABER-Student Assessment practices, which standardize national large-scale assessments (NLSA) to qualitatively quantify four levels of education system development. SABER recognizes that a systems approach is integral to efficient inputs for learning outcomes. With coverage in at least 100 countries and stated plan to become publicly accessible to stakeholders worldwide, SABER can potentially establish long-term adoption and function as an equalizing instrument for system-wide education reform. However, SABER's myopic measurement error and failure to integrate larger sociocultural system dynamics, despite its repetitive use of 'systems approach' jargon is best demonstrated in its *explicit* time-based promise of, "targeted cross-country learning" (The World Bank, 2013, p. 21).

The World Economic Forum states that human capital is a multidimensional concept with varying meanings for varying stakeholders. Therefore, the WEF Human Capital Index quantitatively measures education and employment outcomes using data compiled from international organizations, such as UNESCO Institute for Statistics. WEF's HCI methodology is guided by three key concepts; educational attainment and employment outcomes, demographics, and standardized country-to-country performance. HCI measures demonstrate exposure to *explicit*

time-based dominant *implicit in* educational enrollment and attainment, which accounts for noticeable misalignments between applied learning, employment, and economic participation outcomes. Although WEF's HCI acknowledges the need for inclusive measures that address economic complexity, technological progress, and enabling endogenous and/or exogenous variables, it fails to acknowledge and subsequently interconnect larger sociocultural system dynamics to its envisioned metric for human development. As such, current *explicit* time-based instructional measures that dominate *implicit in* partial proxy indicator variables, lack the transparency and flexibility required to effectively expand opportunities that offer real freedoms for aligned educational equity, job acquisition, and human development outcomes (WEF, 2015b; Kozulin et al., 2003; Meadows, 2008; Silva et al., 2015).

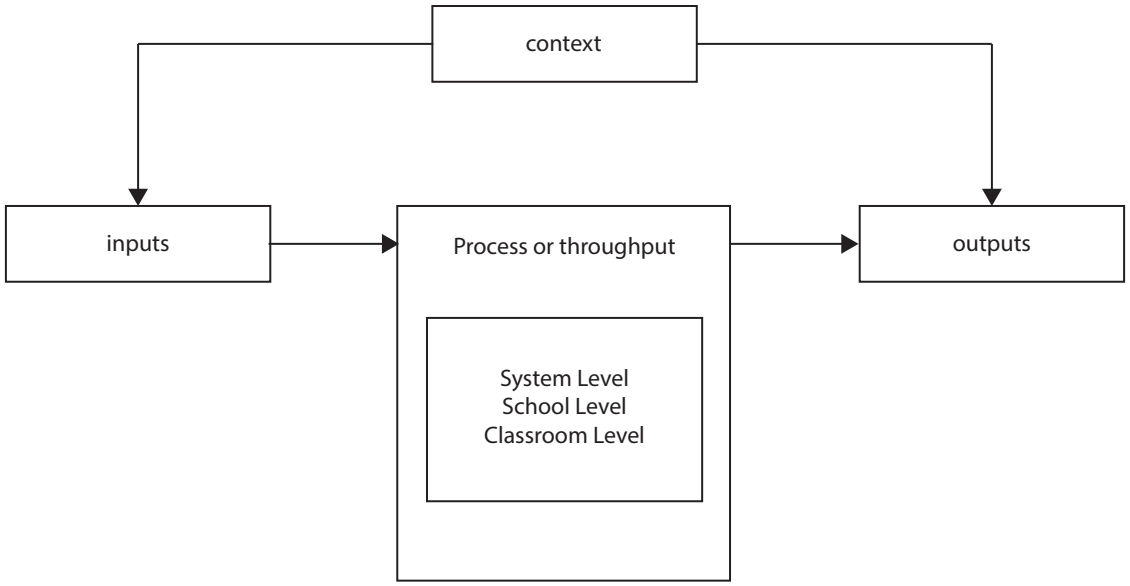
UNESCO, OECD, The World Bank, UNDP, and WEF indicators and indices are informed by centralized education systems, asynchronous data sets, and inextricably linked *explicit* time-based instructivist laden *implicit in* partial metrics. Constrictive endogenous and exogenous system traps identified in current measures of centralized education systems, structurally hinder interconnections and flows of information necessary to capture the complexity of larger sociocultural system dynamics. Current *implicit in* partial indicators targeted for educational performance violate the basic tenets of Goodhart's law, which call attention to the inherent efficiencies of flexible discriminators as a quality measure (Silva et al., 2015; Meadows, 2008; Watkins, 2012; Strathern, 1997).

5.3 Standardized *Explicit* and *Implicit In* Input, Output, and Outcome Measures

Currently, little to no standardized metrological consensus exists between large-scale offline instruction stakeholders in terms of input and output characteristics that equalize educational outcomes and advance human development. UNESCO, OECD, the United Nations,

The World Bank, and the World Economic Forum are tasked to monitor, report, and administer *explicit* time-based dominant *implicit in* partial indicators and indices across developed and developing populations. However, the complexity that technological progress exacts upon weighted endogenous and exogenous variables which influence said measures, has yet to be addressed by governing metrological practitioners. (UNESCO, 2014; UNESCO, 2013; UNESCO Institute for Statistics, 2014; OECD, 2014; OECD, 2015; UNDPa, 2015; UNDPb, 2015; WEF, 2015b; The World Bank, 2013).

The absence of adopted measures for dynamic large-scale online instruction further compounds the lack of consensus surrounding current input, output, and outcome characteristics in relationship to realizable quality learning outcomes in the Digital Age. As a result, the terms input, output, and outcomes are liberally applied in general and often miscalculated by international organizations mandated to monitor, report, and administer educational outcomes and human development. Although substantial resources are expended on the global oversight of educational attainment, performance and improvement outcomes, a common framework of measurable inputs, outputs, and outcomes has neither been adopted nor standardized. One interpretation of measured education can be defined as a production process, where inputs are contextually processed through centralized instructional levels to produce metered educational attainment, performance, improvement outputs, and quality outcomes, as illustrated in Figure 5.1. The assignment of indicators to each stage of the production process framework further demonstrates the hierarchical internal structure of centralized education systems (Scheerens, 201



Note. Adapted from Perspectives on Educational Quality, p. 36, by J. Scheerens et al., 2011, SpringerBriefs in Education.

Figure 5.1 A Basic Systems Model on the Functioning of Education

The variability of characteristics and classifications between inputs, outputs, and outcomes and misalignment of what are termed as 'non-input factors,' clearly highlight the narrow interpretation and lack of consensus regarding a common framework of measurable inputs, outputs, and outcomes. For example, The World Bank's SABER initiative states that it seeks to, "recognize education as a system, not just a collection of inputs...any education system is a complex network...the strategy calls for governments and donors to focus much more on improving the non-input factors that drive learning—the information flows, accountability relationships, incentives, financing structures, and behaviors, both within and outside the formal education system" (The World Bank, 2013, p. 25).

Therefore, a unifying theoretical construct to configure future alternative measures for dynamic high-impact quality learning outcomes must be understood as a natural product of the configurative multi-input and output process and defined as process principled product constructs (Alexander et al., 2009).

Chapter 6 A Unifying Theoretical Construct to Configure Future Alternative Measures for Dynamic Large-Scale Online Learning and Reconfigure Current Antecedent Time-Based Instruction Explained

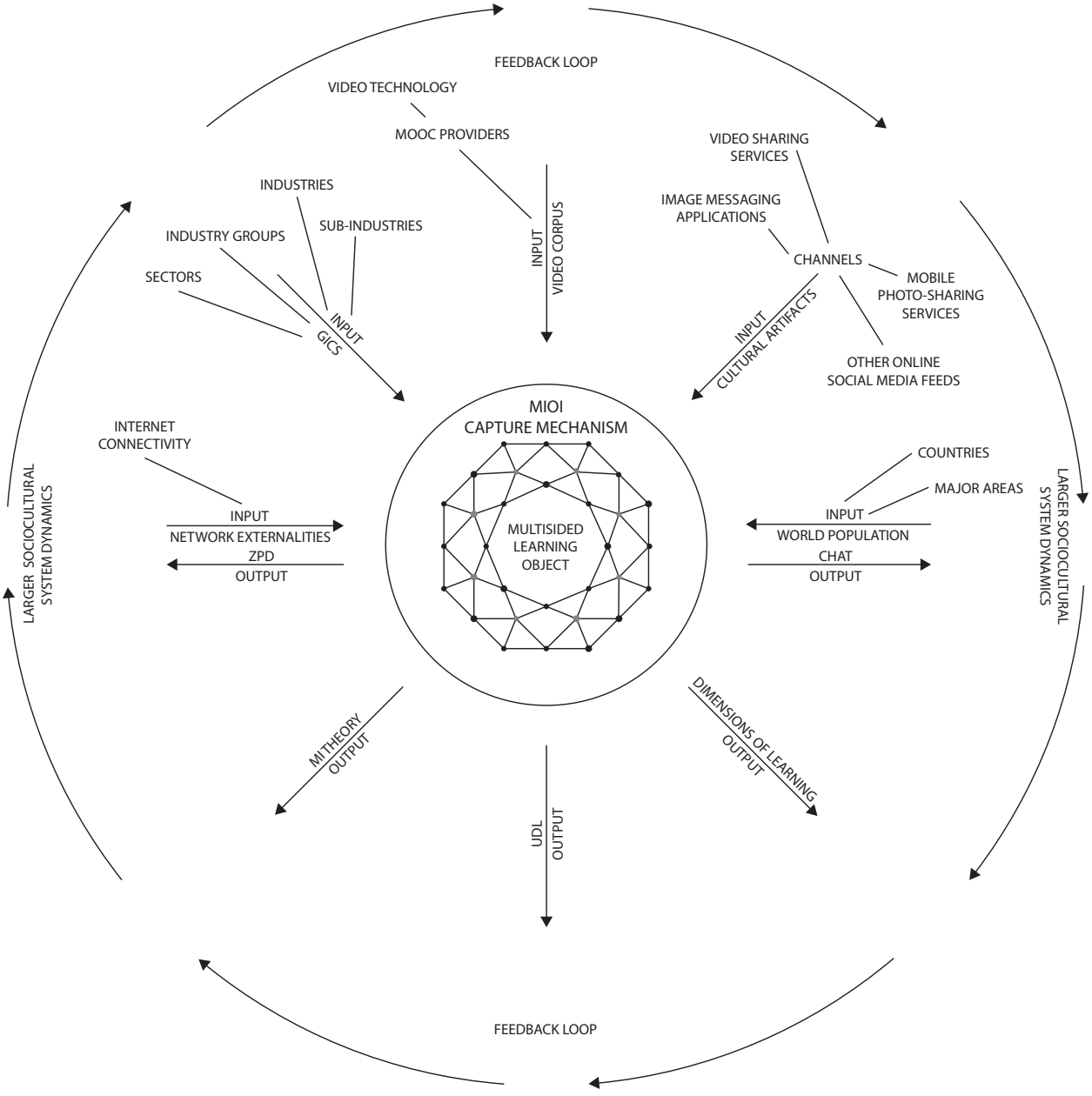


Figure 6.1 MIOI Capture Mechanism Exhibit A

6.1 Proposed MIOI Capture Mechanism

A pressing need exists for a unifying construct to configure future alternative measures for dynamic large-scale online learning, especially in China and India where, "educational demand radically outstrips supply" (Reich, 2015b). The proposed theoretical construct could potentially help to improve educational equity and serve as an, "alternative formulation of equality" (Sen, 1979, p. 197). Antecedent *explicit* time-based credit hour derived metrics can provide a reconfigurable underlying corpus of instruction for the proposed construct and may also continue to transfer common application and administrative efficiencies (Silva et al., 2015). *Explicit* time-based instructional metrics and derivative *implicit in* partial indicators are inextricably tethered to centralized asynchronous large-scale online instruction, in fact, “it's hard to imagine what we report that isn't credit based...there is nothing simple about measuring the quality of learning. The reason for the robustness of the Carnegie Unit is not that it’s the best measure, just that it’s much more difficult than folks think to replace it” (Silva et al., 2015, p. 30). Therefore, the proposed theoretical construct could function as a platform and pedagogy agnostic learning object situated architecture system, which measures multidirectional and multidimensional learning interactivity between the Learner, the course content, and larger sociocultural system dynamics of multiple inputs and outputs (Hutchins, 1996; Meadows, 2008; The World Bank, 2013).

The ChinaX MOOC prior art supports the feasibility of the proposed high-impact MIOI capture mechanism construct and its learning object feature, which could improve *transparency* and *flexibility* efficiencies in large-scale online learning settings (Ho et al., 2015). The proposed construct for future proxy indicators of learning could reconfigure constrained antecedent bundles of time-based large-scale instruction, through a decentralized synchronous learning object enabled MIOI capture mechanism optimized by video and MOOC ecosystem technologies (Ho et al., 2015;

Hollands & Tirthali, 2015; Hollands & Tirthali, 2014; Guo et al., 2014). The proposed multisided learning object situated MIOI capture mechanism could function as an open decentralized synchronous construct to produce measurable process principled learning configurations that offer *transparency* and *flexibility*, as illustrated in Figure 6.1, as opposed to the closed and constrained centralized asynchronous instructional production framework illustrated in Figure 5.1 (Alexander et al., 2009; Scheerens, 2011).

The proposed construct to measure learning efficiencies in large-scale online settings could further improve aligned learning and skills diffusion outcomes, job acquisition, and human development. Future alternative digital processes that reconfigure current metrological design deficiencies, leverage existing transferable instructional design efficiencies, and produce a diverse spectrum of measurable learning configurations could offer realizable opportunities for the advancement of high-impact quality learning outcomes and educational equity worldwide. Accordingly, a bricoleur systems thinking approach has been adopted to gain praxiological insights into measures of value that qualitatively quantify culturally constituted learners as an underutilized resource with unique transferable cognitive processes and utility function. Educational equity and aligned human capital resource allocation can be best achieved when all Learners play a mutually reinforcing role in the production of process principled learning configurations (Sen, 1979; Alexander et al., 2009). The capacity of culturally constituted human agency to discern, capture, and sequence the multiplicity of configurative unit operations into actionable learning configurations could redefine what it means to be authentically educated in a digitally mediated world (Bogost, 2006). As such, said proposed learning object situated MIOI capture mechanism construct could equitably enable the unbundling of organized education to establish future alternative measures for dynamic large-scale online learning.

Therefore, for purposes of standardization, the exploratory research design and methodology of said proposed theoretical construct has been framed through the bricoleur systems thinking lens of generalized multiple inputs and outputs optimized by video and MOOC ecosystem technologies (Meadows, 2008; OECD, 2014; The World Bank, 2013; Ho et al., 2015; Guo et al., 2014).

6.2 Supporting Prior Art: ChinaX

The ChinaX MOOC course designed by HarvardX course developer, Junjie Liu, best demonstrates incremental advances in large-scale online learning metrics to date. ChinaX, an experimental MOOC offered by HarvardX on the edX platform offers a historical overview of China's rich history on its surface (LWMOOC, 2014). However, behind ChinaX's great digital wall, Junjie Liu's design thinking, albeit predictably linear is considered, "a striking illustration of the potential of well-sequenced, modular content...a case study with implications for the design and implementation of MOOCs" (Ho et al., 2015, p. 21).

ChinaX is offered as a series of ten 4 to 8 week modules also referred to as mini-courses to be taught over a duration of one year. In total, ChinaX had 50 weeks of content from which to experiment on instructional design and metrics to improve upon intercultural understanding, teacher-student collaboration, and the large-scale online learning experience in general. Liu tested the efficacy of several pedagogies and technologies to determine best practices in a large-scale online learning environment. Each mini-course was launched on a Thursday and followed-up with an office hours video the following Wednesday to reinforce the past week's learning experience and update Learners on what to anticipate in the next mini-course. Weekly analysis of asynchronous and application of semi-synchronous metrics within the hyper-centralized instructivist design of the ChinaX MOOC include: participation and performance analytics;

survey, poll and other channel feedbacks, and temporally progressing content (LWMOOC, 2014).

In contrast to traditional asynchronous xMOOCs, "ChinaX is not a static-content course with multiple versions, but rather a series of modules or "mini-courses" with progressing content" (Ho et al., 2015, p. 10). Thus, the ChinaX design demonstrates, "strong course pathways in both participation and certifications" (Ho et al., 2015, p. 21). The semi-synchronous modularization, feedback loop, and progressive sequence design of ChinaX is of particular importance to substantiating the viability of future alternative measures for dynamic large-scale online learning.

6.3 MOOC

The term, massive open online course (MOOC), was coined in response to an experimental course designed by George Siemens and Stephen Downes in 2008 entitled, "Connectivism and Connective Knowledge (CCK08)" (Crosslin & Dellinger, 2015, p. 250). CCK08 was an amalgamation of evolving ideas surrounding large-scale enrollment, online learning, and open courses. Siemens refers to connectivism as, "a process that occurs within nebulous environments of shifting core elements – not entirely under the control of the individual. Learning (defined as actionable knowledge) can reside outside of ourselves (within an organization or a database), is focused on connecting specialized information sets, and the connections that enable us to learn more are more important than our current state of knowing" (Crosslin & Dellinger, 2015, p. 251). Power dynamics are central to MOOC efficiencies and future alternative measures for dynamic large-scale online learning. The multidirectional and multidimensional interplay between Learners must equalize the, "allocation of power dynamics" (Crosslin & Dellinger, 2015, p. 251).

Meaningful metrics to unpack the intrinsic value of current dynamic large-scale online instruction (MOOCs) within the context of a centralized asynchronous instructivist framework

have yet to be realized. The practical application of current MOOC metrological practices in relationship to the dynamic alignment and advancement of opportunities, capabilities, and economic mobility across diverse populations has not been quantified to date. Metrics that qualitatively quantify how MOOCs make people more interconnected, differentiated, and productive remain unclear as well. MOOC researchers state that, "despite having numerous robust discussions surrounding the value of our MOOC data, we have made less headway in answering some of the more fundamental questions about the nature and purpose of MOOCs. In particular, our research group has spent considerable time unpacking the various definitions of traditional metrics for student learning, such as “who counts as a participant?” and “what does learning mean in the context of MOOCs?” One of the most exciting – as well as frustrating – aspects of researching student learning in the context of MOOCs is having the ability to create standards by which to measure success" (Shrader & Mock, 2014). In contrast, the proposed construct to configure future alternative measures for dynamic large-scale addresses the digitally mediated interplay between culturally constituted learners within the context of a decentralized synchronous configurative construct.

6.4 Video

The industrial Age marked the invention of filmmaking in addition to organized education. Film editing as a form of filmmaking was introduced into modern culture shortly after the turn of the nineteenth century. Infinitely more than the mere cutting out of undesired sequences of images, "editing is structure, color, dynamics, manipulation of time" (Murch, 2001, p. 10). Sergei Eisenstein, the revolutionary Soviet filmmaker and pioneer of montage theory declared filmmaking as, "the next dimension of means of expression" (Taylor, 1998, p. 4). Common sense would lead most reasonable people to believe that with a highly ordered visual perception of time

and space dating back to the inception of life, "our brains had been 'wired' by evolution and experience to reject film editing" (Murch, 2001, p. 6). However, nothing could be further from the truth. The interaction of two thinking systems, System 1 - rapid automatic response and System 2 - ordered thought construction, accounts for the human brain's ability to recognize and allocate attention to displaced narrative sequences, more so than continuous narrative sequences (Kahneman, 2011).

6.5 Systems Thinking

On a systems level, the proposed unifying theoretical construct to configure future alternative measures for dynamic large-scale online learning must include three fundamental things, " elements, interconnections, and a function or purpose" (Meadows, 2008, p.11). Therefore, *elements* are Learners: students, teachers, educational institutions, researchers, enterprise, organizations, and private foundations. The *interconnections* are sequenced process principled learning product constructs captured through *transparent* and *flexible* multidirectional and multidimensional inputs and outputs. Whereas, the *function* is to enable heterogeneous high-impact quality learning outcomes between education systems and larger sociocultural system dynamics for equalized learning efficiencies and aligned human development. The proposed construct to configure future alternative proxy indicators for dynamic large-scale online learning within the context of a decentralized synchronous constructivist framework recognizes that, "a diverse system with multiple pathways and redundancies is more stable and less vulnerable to external shock than a uniform system with little diversity" (Meadows, 2008, p. 4). The Bill & Melinda Gates Foundation, the world's largest-scale private foundation states that, "if we are going to change people's lives, we need another level of innovation. Not just technology innovation – system innovation" (Bill & Melinda Gates Foundation, 2015).

6.6 Culturally Constituted Learner

Culturally constituted learners are defined as students, teachers, educational institutions, researchers, enterprise, organizations, and private foundations optimized by the complexity of larger sociocultural system dynamics (Meadows, 2008). The proposed unifying construct to configure future alternative measures for dynamic large-scale online learning acknowledges that, "human cognition is not just influenced by culture and society, but that it is in a very fundamental sense a cultural and social process" (Hutchins, 1996, p. xiv). Differentiated learning structure efficiencies and cognitive properties between individuals and groups demonstrate that, "human cognition is always situated in a complex sociocultural world and cannot be unaffected by it" (Hutchins, 1996, p.xiii).

6.7 Learning Object

Foundational principles and dimensions of human learning define the learning object as an interactional (*Principle* 9) process principled product construct (*Principles* 7 & 8) that operates across all four dimensions of the, "what, where, who, and when of learning...involves the continual interplay of multiple dimensions at any point or under any circumstance...interplay among these four dimensions results in a shape to learning that is fluid and dynamic" (Alexander et al., 2009, pp. 180-181). Learning objects interconnected to larger sociocultural system dynamics measure how learning unfolds in relationship to well-structured multidirectional and multidimensional inputs and outputs. Multisided learning objects could sequence the multiplicity of configurative unit operations into actionable learning configurations in hyper-time to manipulate time and amplify learning experiences. In the case of the proposed learning object situated MIOI capture mechanism optimized by video on edX MOOC provider and powered by Open edX open source platform, multisided learning objects are informed by the culturally constituted interactive

sequencing of multiple inputs and outputs (Alexander et al., 2009; Bogost, 2006; Meadows, 2008; Kozulin et al., 2003). The variability and characteristics of all inputs; video corpus, Global Industry Classification Standard (GICS), Global Research Benchmarking System (GRBS), cultural artifacts, network externalities, and world population and outputs; Universal Design for Learning (UDL), System 1 (Fast Thinking) and System 2 (Slow Thinking), Zone of Proximal Development (ZPD), Cultural-Historical Activity Theory (CHAT), foundational principles and dimensions of human learning, Multiple Intelligences (MI) theory; hot "high definition" and cool "low definition" media theory, and cognitive ethnography are integral to the functionality of the proposed learning object situated MIOI capture mechanism construct. It is also important to note that the proposed theoretical multisided learning object discriminator is *transparent* and *flexible*, whereas traditional learning objects are not.

6.8 Proposed MIOI Capture Mechanism Process

The proposed unifying theoretical construct to configure alternative measures for dynamic large-scale online learning could function as a platform and pedagogy agnostic learning object situated architecture system, which measures multidirectional and multidimensional learning interactivity between the Learner, the course content, and larger sociocultural system dynamics of multiple inputs and outputs. This theoretical construct leverages video and MOOC ecosystem technologies to digitally mediate, "the dynamic nature of learning, which...is in continual flux" (Alexander et al., 2009, p.176). Video technology and video editing in particular have the capacity to psychometrically capture and reconfigure space and time into a montage of measurable platform and pedagogy agnostic interactive multiple input and output learning experiences (Taylor, 1998; Murch, 2001; Khan, 2011; Guo et al., 2014; Alexander et al., 2009). Process principled learning products sequenced through well-structured MIOI architected learning

objects enable the, "viable operationalization of the construct" (Alexander et al., 2009, p.180). Multisided learning objects sequenced within the context of the proposed decentralized synchronous configurative MIOI capture mechanism, exhibit the requisite functionality for teasing culturally constituted learning signals from one-dimensional centralized asynchronous large-scale online instructional MOOCs. MIOIs are differentiated from current fragmented interpretations of measurable inputs, outputs, and outcomes by way of the fundamental *elements, interconnections,* and *function* of said proposed alternative measures (Meadows, 2008). Hence, proposed learning object situated MIOI capture mechanism efficiencies offer measurable interventions that mediate Carnegie Unit derived *explicit* and *implicit in* time-based constraints and improve upon current *transparency* and *flexibility* deficiencies that hinder the efficient capture of dynamic high-impact quality large-scale online learning outcomes (Guo et al., 2014; Ho et al., 2015; Hutchins, 1996; Reich, 2012a; Silva et al., 2015). Therefore, the proposed MIOI capture mechanism construct to configure forward-looking alternative measures demonstrates that, "learning is a multidimensional process that results in a relatively enduring change in a person or persons, and consequently how that person or persons will perceive the world and reciprocally respond to its affordances physically, psychologically, and socially. The process of learning has as its foundation the systemic, dynamic, and interactive relation between the nature of the learner and the object of the learning as ecologically situated in a given time and place as well as over time" (Alexander et al., 2009, p.186).

The need for the proposed MIOI capture mechanism and learning object feature to realign inefficiencies caused by MOOC fragmentation further suggests that, "the instructional and policy implications of large-scale online courses vary from course to course, field to field, and context to context "(Reich, 2015b). MOOC inefficiencies are largely the result of antecedent legacy

constraints. The retro one-size-fits-all overlay of centralized asynchronous Carnegie Unit derived *explicit* and *implicit in* time-based instruction onto programmatic large-scale online instructional platforms creates a time warp effect that constrains authentic learning outcomes. In fact, the half-life of digitally repurposed *explicit* and *implicit in* time-based instruction is documented in, "the largest-scale study of video engagement to date, using data from 6.9 million video watching sessions across four edX courses" (Guo et al., 2014, p. 10). Current MOOC metrics of engagement are premised upon, "the length of time that a student spends on a video (i.e., video watching session length) as the main proxy for engagement" (Guo et al., 2014, p. 3). MOOC content is typically delivered in a one-hour instructional lecture format. Although new findings encourage chunking large-scale instructional video sequences down to at least 6 minutes, -- "main findings are that shorter videos are much more engaging...informal talking-head videos are more engaging...the shortest videos (0–3 minutes) had the highest engagement and much less variance than all other groups" (Guo et al., 2014, pp. 1-4). As such, video technologies are central to dynamic large-scale online instruction, however, "despite the heavy investment and emphasis on video in many MOOCs, students need to do stuff to learn" (Reich, 2015c). Hence, the balanced allocation of power dynamics to extend Learner cognition is attainable through the proposed learning object situated MIOI capture mechanism optimized by video and MOOC ecosystem technologies, "when we assert that learning is interactional...that learning engages an intermutual sequence of operations that are shaped by human culture and biology, among a host of such influences, and by how humans act and react to a dynamically changing world. All serious discussions of learning would agree that the world “out there” matters to how learning takes place" (Alexander et al., 2009, p.180).

The proposed MIOI capture mechanism construct, as illustrated in Figure 6.2, Figure 6.3, and Figure 6.4 demonstrates a three stage decentralized synchronous multisided learning object situated interactive reconfiguration and configuration process. Stage one: Learners initialize their Learner dynamic also referred to as *elements,* as illustrated in Figure 6.7 to actuate the proposed MIOI capture mechanism, thus unfolding, "dimension 3: the who of learning" (Alexander et al., 2009, pp.184). Learner dynamics are interactional within the proposed Learner framework and can therefore be theoretically layered to amplify culturally constituted learning signals that inform the proposed multisided learning objects. The edX MOOC provider and online learning research platform, Open edX open source platform, and open source video platform are operational throughout the above referenced three stage learning object situated MIOI capture mechanism process optimized by video and MOOC ecosystem technologies. The video corpus input, as illustrated in Figure 6.5 is now initiated. The Learner selects a course of interest and is provided with a visual course syllabus, which operates as a MIOI recognition system (Crosslin & Dellinger, 2015). Although the visual course syllabus is situated, the *interactive complexification* of multidirectional and multidimensional inputs, as illustrated in Figure 6.5 and outputs, as illustrated in Figure 6.6 unfold, "dimension 1: the *what* of learning" (Alexander et al., 2009, pp.181). In the case of a selected edX information technology course, learning signals would inform GICS, GRBS, and network externality inputs across at least 193 UN Member State countries, as illustrated in Figure 6.5. GICS inputs would interconnect with at least one aligned sector. For example, sector, industry group, industry, and sub-industry classification numbers would subsequently inform the enterprise for feedback loop alignment to culturally constituted learners (S&P Capital IQ, 2014; Global Research Benchmarking (GRBS), 2012; United Nation, 2015a). One side of the learning object is then informed and measured by said input sequence. The Learner

then activates the output matrix, selects at least one UDL measured principle from 1.1 - 9.3 and at least one unique parameter setting from System 1 (Fast Thinking) and System 2 (Slow Thinking), ZPD, CHAT, foundational principles and dimensions of human learning, MI theory, or hot "high definition" and cool "low definition" media theory (CAST, 2012). The Learner is now oriented to construct an output sequence, as illustrated in Figure 6.6 in that, "a comprehensive rendering of learning must give due consideration to the objects or foci of that dynamic system (Giussani, 1995). There is always a what that is being learned or that is in the process of change. Further, there is ample evidence that the objects of learning are distinguishable and classifiable, and that those differences are significant in how the process of learning unfolds" (Alexander et al., 2009, p.181). The proposed MIOI capture mechanism optimized by video and MOOC ecosystem technologies is further initiated to capture centralized asynchronous instructional video lectures (course content) that are aligned with *interconnected* inputs. This iterative process of dynamic input and output sequencing informs the proposed measurable multisided learning object at many data points, as illustrated in Figure 6.1, Figure 6.2, Figure 6.3, and Figure 6.4.

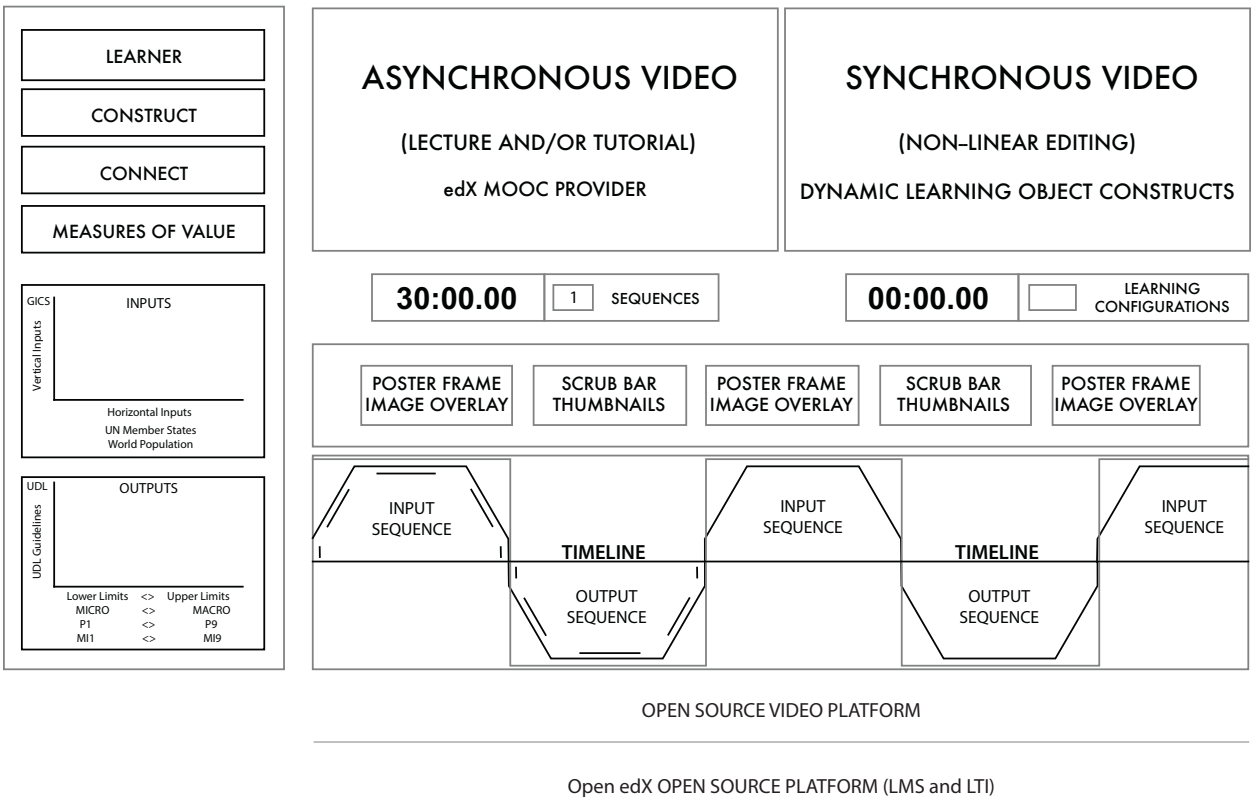


Figure 6.2 MIOI Capture Mechanism Exhibit B

Stage two: well-structured MIOIs and well-balanced sociocultural feedback loop power dynamics allow the proposed multisided learning objects to be sequenced in hyper-time, as illustrated in Figure 6.3 thus unfolding, "dimension 4: the *when* of learning" (Alexander et al., 2009, pp.185). The platform and pedagogy agnostic unbundling of current centralized asynchronous time-based bundles of measured instruction occurs in states of interconnected hyper-time, where all inputs and outputs are symmetrically aligned, as illustrated in Figure 6.9. The Learner is now informed by the proposed learning object enabled MIOI capture mechanism that video sequencing has been synchronously chunked down from 30 minutes to 6 minutes in length. This is when the proposed multisided learning object feature reconfigures the course content, as

illustrated in Figure 6.3 as, "there is always a temporal nature to learning. As humans, our movements in the world are inevitably constrained both by time and space. With each imperceptible moment, the frame for learning has shifted, not merely because the place itself has changed (e.g., light refractions or creature movements), but because the learner himself or herself has changed, however inconspicuously, from Time 1 to Time 2. Thus, a learning moment can never be duplicated, only approximated. It is precisely because of the invasiveness of time throughout this topography that we conceive of it as a force that must be addressed" (Alexander et al., 2009, p.185).

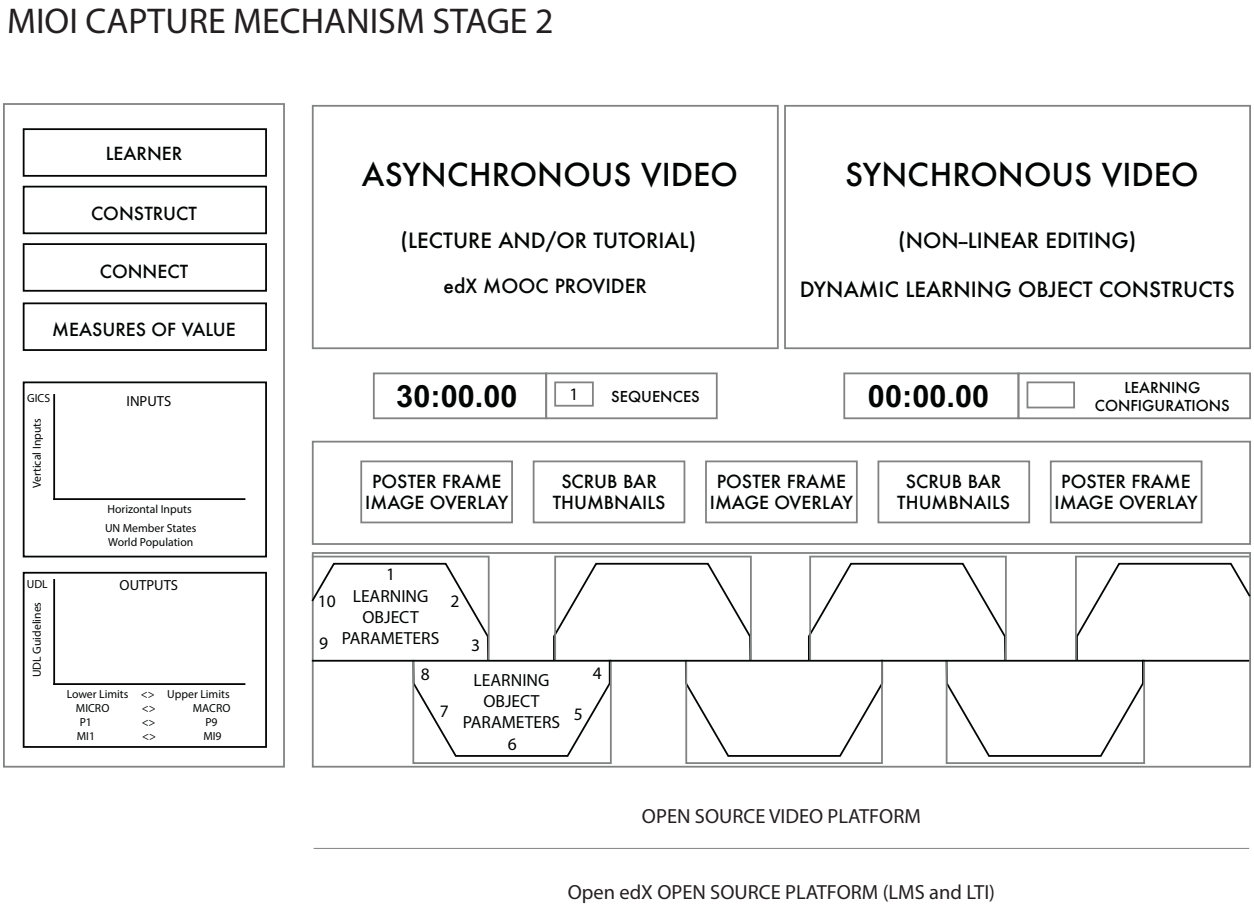


Figure 6.3 MIOI Capture Mechanism Exhibit C

Stage three: all sides of the learning object are qualitatively quantified into learning configurations (Bogost, 2006; Guo et al., 2014). Based on the Learner's increasingly optimized interactivity, the multisided learning object reconfigures the video lecture into a 3 minute informed course lecture through the proposed MIOI capture mechanism construct, as illustrated in Figure 6.4 to unfold, "dimension 2: the where of learning" (Alexander et al., 2009, pp.183). Culturally constituted learning experiences and quality outcomes are found and *function* where synchronous interactional MIOI engagement occurs, "because contexts are themselves always changing, the learner must continue to adjust, adapt, and broaden the application of what was learned and to respond appropriately to contextual cues in the here and now that are close enough but slightly different from the context that was in place when learning “began”" (Alexander et al., 2009, p.184).

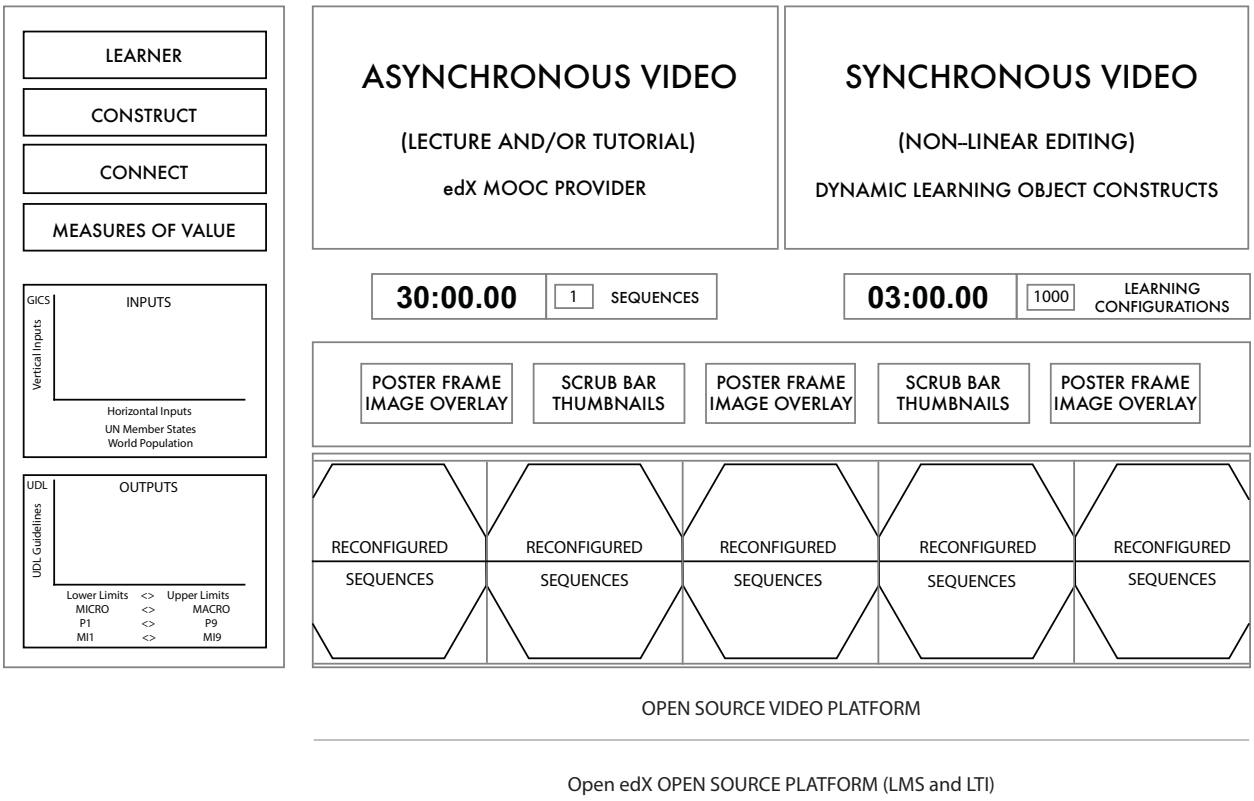


Figure 6.4 MIOI Capture Mechanism Exhibit D

6.9 Inputs

Video Corpus

The video corpus from 37 qualified MOOC providers offers at least 4200 online courses from approximately 550 partnering universities to an estimated 35 million students. Video corpus inputs provide course content that could facilitate information flows, proposed learning object enabled MIOI capture mechanism sequencing, and hyper-time reconfiguration for aligned alternative measures and applied human capital resource allocation. The MOOC provider video corpus consists of course content from the following subject areas: Architecture, Art & Culture, Biology & Life Sciences, Chemistry, Communication, Computer Science, Data Analysis &

Statistics, Design, Economics & Finance, Education, Electronics, Energy & Earth Sciences, Engineering, Environmental Studies, Ethics, Food & Nutrition, Health & Safety, History, Humanities, Language, Law, Literature, Math, Medicine, Music, Philosophy & Ethics, Physics, Science, and the Social Sciences (Class Central, 2011-2016).

Global Industry Classification Standard (GICS)

The Global Industry Classification Standard (GICS) is a structured four tier framework that includes sectors, industry groups, industries, and sub-industries. GICS inputs could facilitate information flows and potentially enable interconnections for aligned proposed alternative measures and applied human capital resource allocation. Specifically, the GICS methodology provides an analysis of the following ten (10) sectors: energy, materials, industrials, consumer discretionary, consumer staples, healthcare, financials, information technology, telecommunication services, and utilities. All sectors are given a numerical classification as are their respective twenty-four (24) industry groups, sixty-seven (67) industries, and one hundred and fifty-six (156) sub-industries (S&P Capital IQ, 2014).

Global Research Benchmarking System (GRBS)

The Global Research Benchmarking System (GRBS) identifies and measures research performance in varying disciplinary and interdisciplinary subject areas from at least 1,336 universities worldwide for purposes of advancing and distributing research-based learning outcomes. GRBS inputs could facilitate information flows and potentially enable interconnections for aligned proposed alternative measures and applied human capital resource allocation. The Global Research Benchmarking System offers weighted rating indicators and research benchmarking to covered universities from the following countries: Australia (34), Austria (17), Belgium (10), Bulgaria (4), Canada (34), China (190), Cyprus (1), Czech Republic (18), Denmark

(8), Estonia (3), Finland (10), France (63), Germany (72), Greece (17), Hong Kong SAR, China (7), Hungary (10), India (44), Ireland (8), Italy (58), Japan (108), Latvia (2), Lithuania (4), Luxembourg (1), Malaysia (8), Netherlands (14), New Zealand (8), Norway (13), Poland (54), Portugal (13), Romania (19), Singapore (3), Slovakia (9), Slovenia (4), South Korea (42), Spain (47), Sweden (19), Switzerland (11), Taiwan, Province of China (35), Thailand (9), United Kingdom (98), and the United States (207) (Global Research Benchmarking (GRBS), 2012).

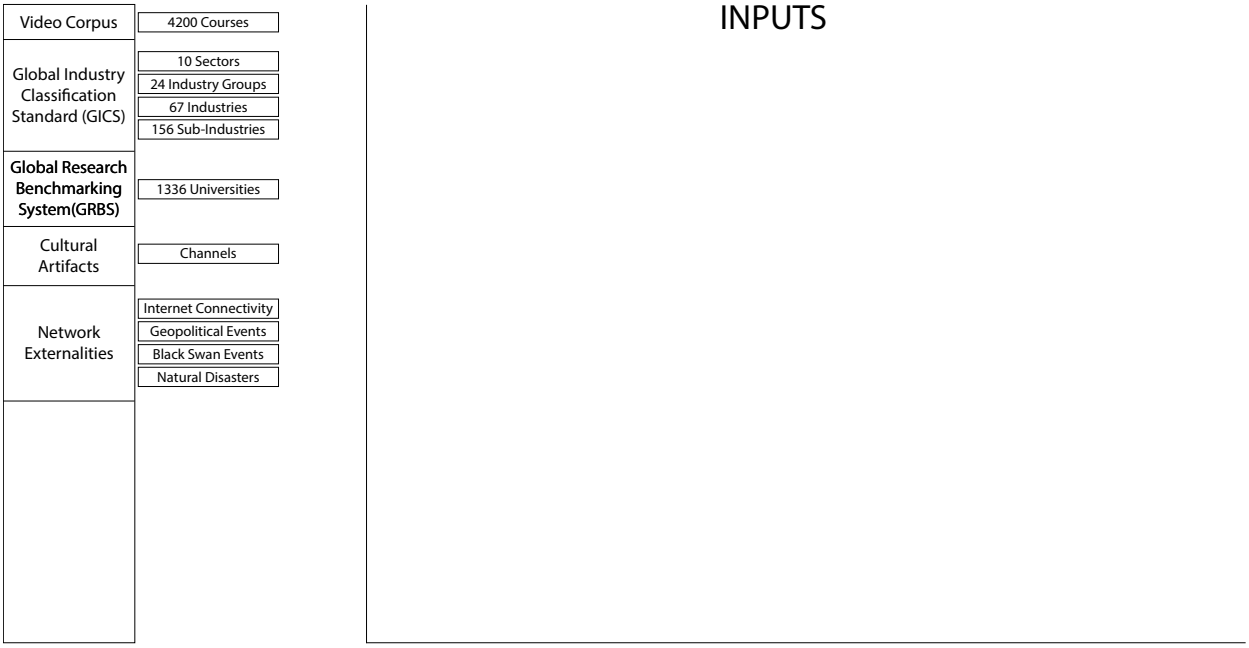
Network Externality

Internet connectivity is an increasingly important network externality that has profound implications on educational equity and sustainable human development. Access to affordable Internet connectivity is a key determinant to the adoption of current dynamic large-scale online educational technologies and proposed future alternative measures for dynamic large-scale online learning in both developed and developing countries. Internet connectivity inputs could facilitate information flows and potential interconnections for aligned proposed alternative measures and applied human capital resource allocation. Internet access is essential to accelerating transformative processes that enrich the choices, opportunities, and economic mobility of diverse populations worldwide. It is estimated that only 37% or 2.7 billion of the world's 7.3 billion potential culturally constituted learners have access to the Internet (Deloitte, 2014; WEF, 2014; Sen, 1999).

World Population

Culturally constituted learners represent a diverse spectrum of learning across heterogeneous populations. World population inputs could facilitate information flows and potentially enable interconnections for aligned alternative measures for dynamic large-scale online learning and applied human capital resource allocation. The world's rapidly increasing population

rate has created a palpable scenario, where the demand for quality large-scale education exceeds its supply. World Population of The World and Major Areas include: Africa, Asia, Europe, Latin America and the Caribbean, Northern America, and Oceania. Currently, there are one billion more people than there were just twelve years ago. The United Nations estimates that the current world population of 7.3 billion will escalate to 8.5 billion by 2030, 9.7 billion by 2050, and 11.2 billion by 2100 (United Nations, 2015b).



193 United Nations Member States from 230 Countries and Major Areas

	World Population	Africa	Asia	Europe	Latin America & Caribbean	North America	Oceania
2015	7.3B	1.2B	4.4B	738M	643M	358M	39M
2030	8.5B	1.7B	4.9B	734M	721M	396M	47M
2050	9.7B	2.5B	5.3B	707M	784M	433M	57M
2100	11.2B	4.4B	4.9B	646M	721M	500M	71M

Note.

Adapted from edX: Free Online Courses from the World's Best Universities, 2015, edX.

Adapted from GICS: Global Industry Classification Standard, 2014, by S&P Capital IQ: McGraw Hill Financial & MSCI, Report by the Commission on the Measurement of Economic Performance and Social Progress.Adapted from GRBS: List of Covered Universities, 2012, by Global Research Benchmarking (GRBS).

Adapted from World Population Prospects: The 2015 Revision, Key Findings and Advance Tables, p. 1 by United Nations: Department of Economic and Social Affairs, Population Division.

Figure 6.5 Framework Input Methodology Exhibit E

6.10 Outputs

Universal Design for Learning (UDL)

Universal Design for Learning (UDL), is an augmentation of the *universal design* architectural movement, which was originally conceived to, "create structures that are conceived, designed, and constructed to accommodate the widest spectrum of users, including those with disabilities, without the need for subsequent adaptation or specialized design" (Rose et al., 2002, p. 70). Hence, UDL can function as an underlying output and flexible framework designed to facilitate culturally constituted multidimensional input-output learning outcomes at many scales of efficiency. As such, Universal Design for Learning supports theories and mediums that can further synthesize and/or complement the multidimensional components of learning, such as Multiple Intelligences theory, which embraces the concept that Learners, "do not have one global learning capacity, but many multifaceted learning capacities" (CAST, 2012; Rose & Meyer, 2006; Brown et al., 2015; Gardner, 2011; Rose et al., 2002, p. 6).

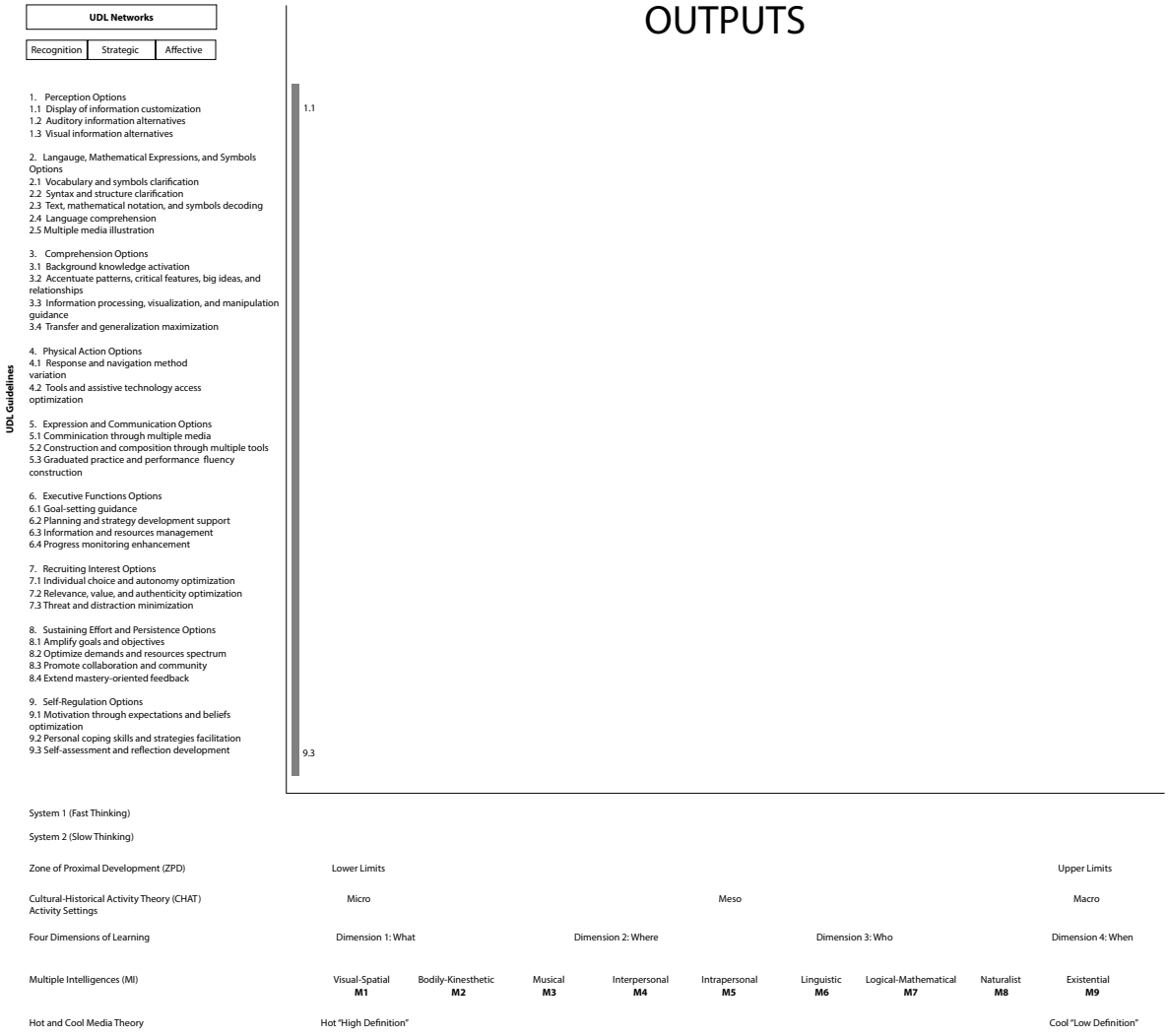
Thus, Universal Design for Learning addresses the what, how, and why of learning by means of three interconnected networks: recognition networks; strategic networks; and affective networks. Premised on the work of Lev Vygotsky, UDL's three primary interdependent neural networks parallel Vygotsky's three prerequisites for learning: "recognition of the information to be learned; application of strategies to process that information; and engagement with the learning task" (Rose et al., 2002, p. 12; Rose & Meyer, 2006). The processing of information across all three UDL networks consists of *distributed* and *hierarchical* characteristics. For example, distributed processing allows for cognitive parallelism in the form of a shape or color to occur, while hierarchical processing mediates bottom-up sensory inputs and top-down contextual inputs.

Recognition networks, the what of learning, distribute processing and subprocessing tasks

across at least 30 brain modules that efficiently process each unit of information into significantly unique *inputs and outputs,* while sharing the same fundamental architecture and performing basically identical general functions, "our recognition networks come in many shapes, sizes, and patterns" (Rose et al., 2002, p. 17). Whereas, strategic networks, the how of learning, include high-order top-down commands complemented by bottom-up targeted skill acquisition. Actionable strategic processing, which influences learning performance suggests that, "the strategic components of everyday tasks serve to illustrate the centrality of strategy for cognition and learning" (Rose et al., 2002, p. 21). Further, affective networks, the why of learning, involve emotionally interacting with the external world on a hierarchical continuum of affective variability and characteristics. The configuration of bottom-up and top-down emotional processing connections determines the symmetry or asymmetry of learning outcomes. Engaged learning enabled by, "bottom-up connections in affective networks ensure that we are emotionally responsive to the outside world (Rose et al., 2002, pp. 32-33).

UDL's recognition, strategic, and affective networks are integral to mediating the what, how, and why of learning. The parallel distributed processing nature of all three networks function to perfect synchronous decentralized multi-task performance across specialized interconnected brain modules to produce differentiated outputs with precision. These hierarchically ordered networks help culturally constituted learners to recognize and therefore identify objects, strategically act on identified objects, and attach affective emotional meaning to identified objects that have been acted upon. Universal Design for Learning principles (also referred to as UDL Guidelines 2.0, Table 3.2) outputs offer multiple measures of *flexible* representation, actionable expression, and engagement for differentiated learning outcomes at many scales. The three UDL operative principles support the networked application of the what, how, and why of learning to,

"minimize barriers and maximize learning through flexibility" (CAST, 2012; Rose et al., 2002, p.74). UDL in general gives culturally constituted learners, "a context for using technology effectively" (Rose & Meyer, 2006, p. 11). Therefore, the parallel distributed bottom-up sensory and top-down contextual modular processing of visual, targeted action, and emotional information germane to recognition, strategic, and affective networks -- applied by measured (1.1 - 9.3) UDL principles in particular as illustrated in Figure 6.6, could have far-reaching implications when employing video and MOOC ecosystem technologies and the proposed learning object situated MIOI capture mechanism construct as levers to configure alternative measures for dynamic large-scale online learning (Rose et al., 2002).



Note.

Adapted from UDL Guidelines 2.0, by CAST, 2012.

Adapted from Thinking, Fast and Slow, by D. Kahneman, 2011, New York: Farrar, Straus and Giroux.

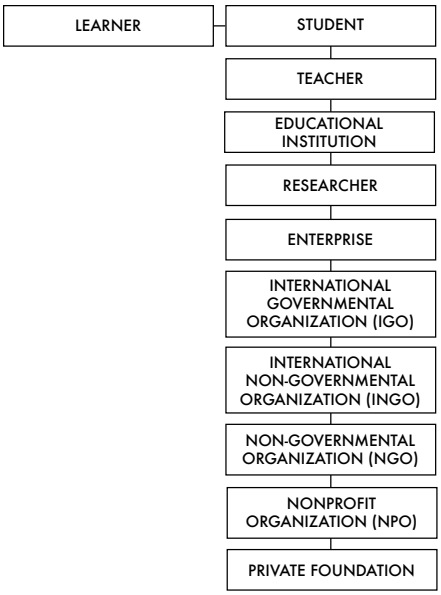
Adapted from Vygotsky's Educational Theory in Cultural Context, pp. 99-105, 274-279, & 383-388, by A. Kozulin, B. Gindis, V. S. Ageyev, & S. M. Miller, 2003, New York: Cambridge University Press.

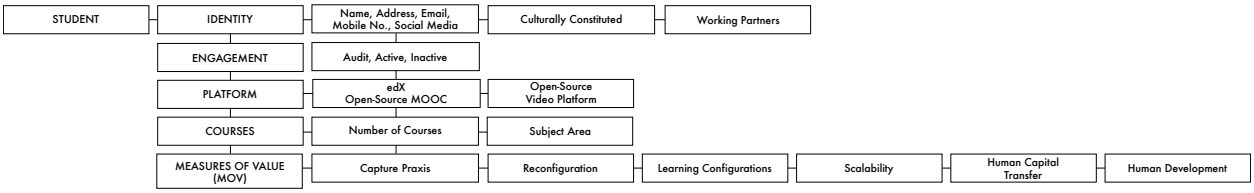
Adapted from What Is Learning Anyway? A Topographical Perspective Considered, p. 5, by P. A. Alexander, D. L. Schallert, & R. E. Reynolds, 2009, Educational Psychologist, 44(3).

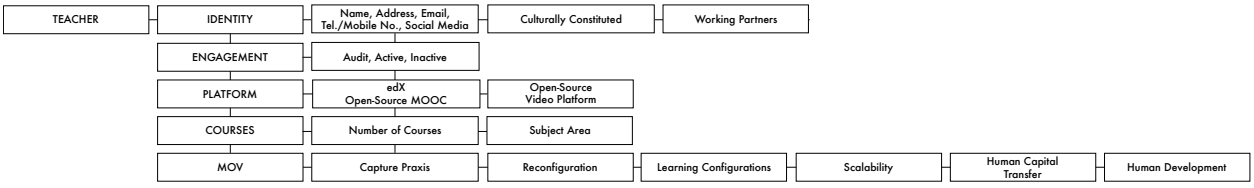
Adapted from Multiple Intelligences: The First Thirty Years, pp. 3-4, by H. Gardner, 2011, Harvard Graduate School of Education.

Adapted from Understanding Media: The Extensions of Man, pp. 22-32, by M. McLuhan, 1964, McGraw-Hill Book Company.

Figure 6.6 Framework Output Methodology Exhibit F


LEARNER
STUDENT
TEACHER
EDUCATIONAL INSTITUTION
RESEARCHER
ENTERPRISE
INTERNATIONAL GOVERNMENTAL ORGANIZATION (IGO)
INTERNATIONAL NON-GOVERNMENTAL ORGANIZATION (INGO)
NON-GOVERNMENTAL ORGANIZATION (NGO)
NONPROFIT ORGANIZATION (NPO)
PRIVATE FOUNDATION


STUDENT
IDENTITY
Name, Address, Email, Mobile No., Social Media
Culturally Constituted
Working Partners
ENGAGEMENT
Audit, Active, Inactive
PLATFORM
edX Open-Source MOOC
Open-Source Video Platform
COURSES
Number of Courses
Subject Area
MEASURES OF VALUE (MOV)
Capture Praxis
Reconfiguration
Learning Configurations
Scalability
Human Capital Transfer
Human Development


TEACHER
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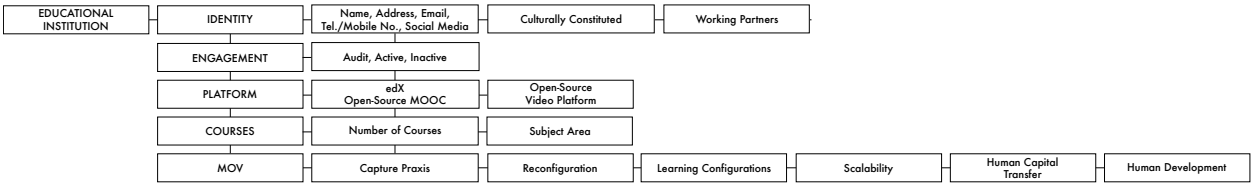
Learning Configurations
Scalability
Human Capital Transfer
Human Development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COURSES
Number of Courses
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MOV
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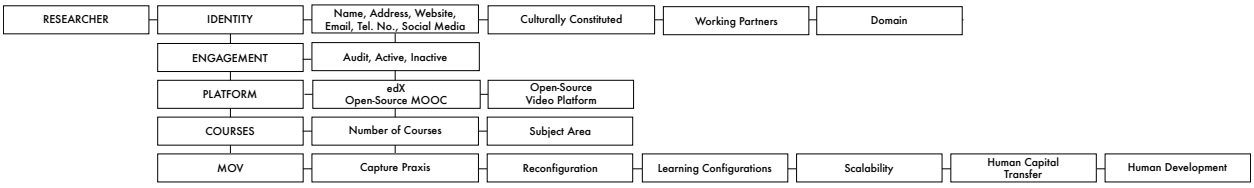
Reconfiguration
Learning Configurations
Scalability
Human Capital Transfer
Human Development


RESEARCHER
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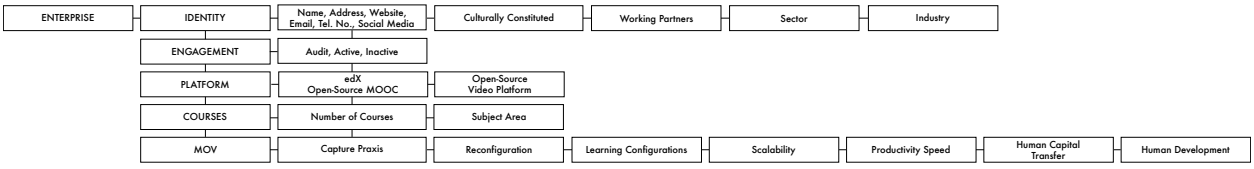
Name, Address, Website, Email, Tel. No., Social Media
Culturally Constituted
Working Partners
Domain
ENGAGEMENT
Audit, Active, Inactive
PLATFORM
edX Open-Source MOOC
Open-Source Video Platform
COURSES
Number of Courses
Subject Area
MOV
Capture Praxis
Reconfiguration
Learning Configurations
Scalability
Human Capital Transfer
Human Development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Learning Configurations
Scalability
Productivity Speed
Human Capital Transfer
Human Development

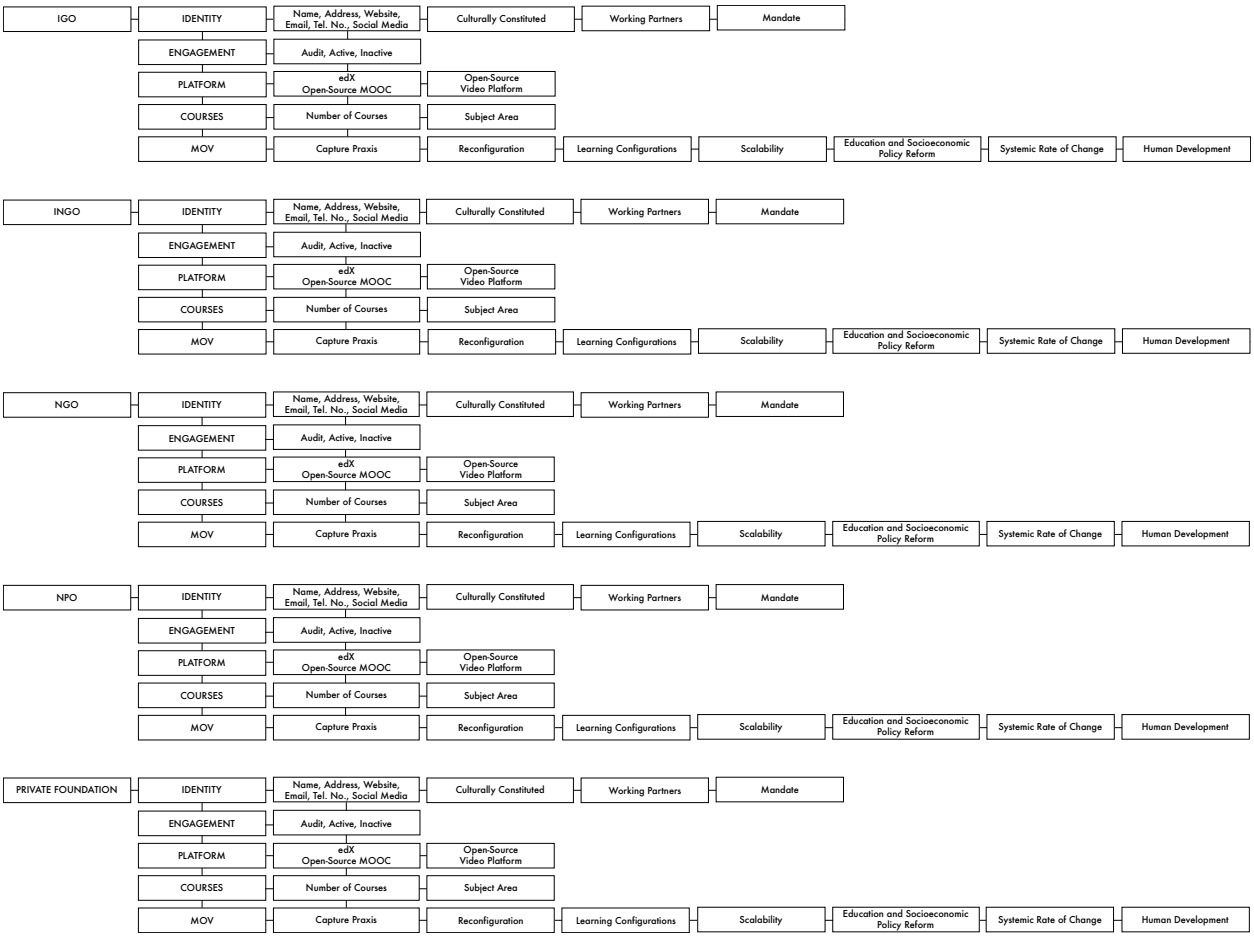

Figure 6.7 Framework Learner Workflow Methodology Exhibit G

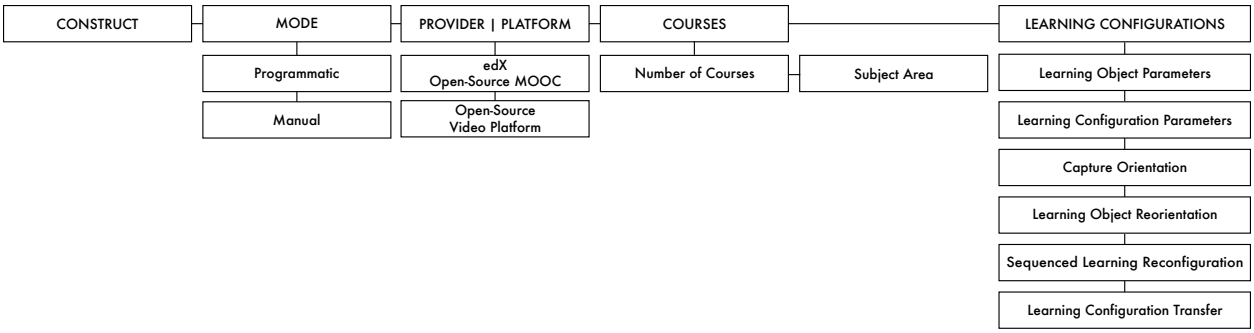

Figure 6.8 Framework Construct Workflow Methodology Exhibit H

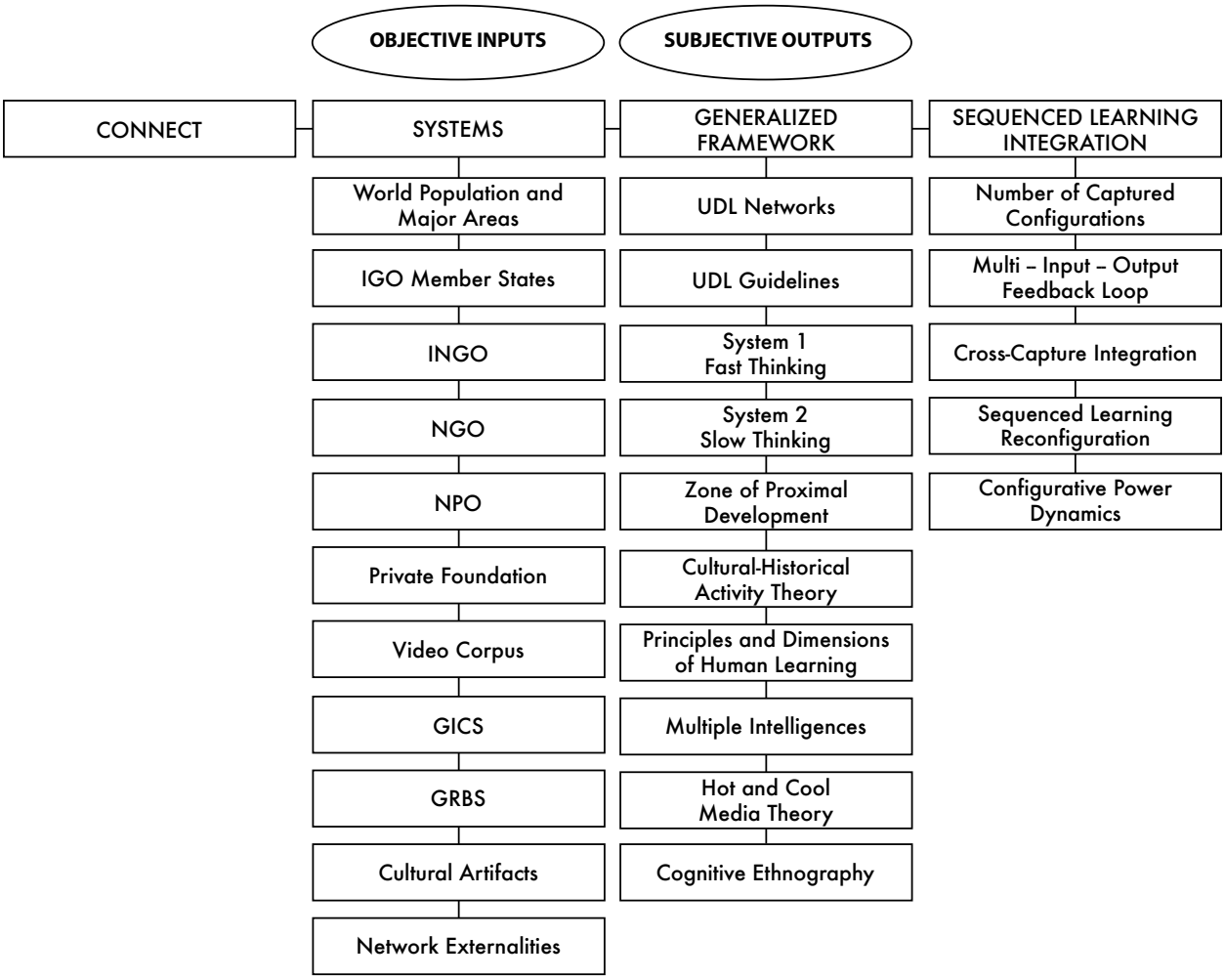

Figure 6.9 Framework Connect Workflow Methodology Exhibit I

Chapter 7 Conclusion

Extraordinary times necessitate extraordinary measures. A warring world gave rise to cultural artifacts addressing the role of education at the end of World War II, the twilight of the Industrial Age. One writing in particular, *General Education in a Free Society*, offers a timeless interpretation of what it can possibly mean to be an educated person. Strikingly, said writing is weighted on inclusive social and moral multidimensional development - the process - by which to serve the greater good, as opposed to the exclusive one-dimensional accumulation of knowledge for purposes of targeted outcomes - the product - (Harvard College, 1950; Alexander et al., 2009). At the dawn of the Digital Age, the warring continues, albeit in a world with heightened ingenuity, connectedness, and consensus that reconciliation is possible through the principled mediation of global educational inequalities. Thus, the underlying insights for the proposed unifying MIOI capture mechanism construct and its learning object feature are found at the intersection of the humanities and technology. These intersecting points of larger sociocultural system dynamics, where Learners and digital technologies possess the potential to interactively construct transformative alternative measures for human development, have been influenced by Ada Lovelace's observation that:

> The Analytical Engine weaves algebraical patterns just as the Jacquard loom weaves flowers and leaves...by the word 'operation,' we mean any process which alters the mutual relation of two or more things, be this relation of what kind it may...supposing, for instance, that the fundamental relations of pitched sounds in the science of harmony and of musical composition were susceptible of such expression and adaptations, the engine might compose elaborate and scientific pieces of music of any degree of complexity.

Digital thought leaders argue that, "if the current pace of technological innovation is maintained, most of the projected eight billion people on Earth will be online...by 2025, the majority of the world's population will, in one generation, have gone from having virtually no access to unfiltered information to accessing all of the world's information through a device that fits in the palm of the hand" (Schmidt & Cohen, 2013, p. 4). Media theorists, Walter Benjamin and Marshall McLuhan foresaw the double-edged impact that digitally enabled mediums posed to the equitable propagation of cultural constituted learning. Benjamin foretold of the dilutive threat of mechanical reproduction on cultural artifacts (Benjamin, 2008). While, McLuhan posited the spectrum of theoretical possibilities of hot "high definition" information mediums and cool "low definition" information mediums, which astutely apply to Internet, video, and MOOC ecosystem technologies (McLuhan, 1964). However, it is McLuhan's coined aphorism, "the medium is the message" that most aptly forewarns the mediated masses to discern, "that the medium is the massage, not the message, that it really works us over, it really takes hold and massages the population in a savage way" (McLuhan, 2005, p.76).

Accordingly, authentic circumstances suggest that the current centralized asynchronous large-scale instructional (MOOC) video corpus could effectively be unbundled and interactively reconfigured at potentially infinite dimensions of scale, speed, and utility by means of the proposed theoretical MIOI capture mechanism construct and its learning object feature. That said, future decentralized synchronous learning object enabled configurative unit operations could function as qualitatively extensible learning moments that leverage and inform the existing video corpus to offset identified instructional constraints, optimize learning *transparency* and *flexibility* efficiencies, and realize new information flows (Guo et al., 2014; Ho et al., 2015; Silva et al., 2015; Meadows, 2008). In contrast, inauthentic circumstances pose legitimate concerns that the latest

increasingly automated large-scale online instructional models will further exacerbate deep-rooted *explicit* and *implicit in* time-based educational inequalities that cannot be fully equalized (Watkins, 2012; Silva et al., 2015; Sen, 1979).

Future research on the technical feasibility and implementation of a learning object situated MIOI capture mechanism proof-of-concept prototype to establish alternative measures for dynamic large-scale online learning could offer far-reaching utility. Forward-looking proxy indicators that capture and effectuate the culturally constituted power dynamics and interactional complexity of large-scale online learning are necessary in that, "the signature challenge that educators face with technology integration is really trying to make sure that technology is always in the service of learning goals" (Reich, 2015a). As such, the proposed MIOI capture mechanism prototype and its learning object feature could leverage the edX MOOC provider and online learning research platform, Open edX open source platform, and technically compatible open source video platforms and editing tools. An estimated video corpus of 4200 online courses from 37 qualified MOOC providers and at least 550 partnering universities could also be leveraged, where Creative Commons licensing options for *transparent* and *flexible* instructional video reconfiguration apply (edX, 2015a; edX, 2015b; Class Central, 2011-2016; Guo et al., 2014). Moreover, proprietary methodologies and algorithms may also be included in said proposed future research. For the reasons explored and expounded upon in this foundational thesis, the rising tide of future alternative measures for dynamic large-scale online learning could effectively lift all Learners at many scales of value to advance the science of learning, foster education reform, incentivize socioeconomic development across heterogeneous populations, and repurpose what it means to be educated in the Digital Age (Hutchins, 1996; Alexander et al., 2009; Sen, 1999; Educause, 2015).

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