Blockchain Revolution
Author: Feng Hou

Blockchain as a distributed ledger technology (DLT) has been touted as a game changer that can fundamentally disrupt our education system and even learning itself. American Council on Education (ACE) President Ted Mitchell writes in the Forward of its recent report "CONNECTED IMPACT - Unlocking Education and Workforce Opportunity Through Blockchain" (ACE Report) that "Blockchain, in particular, holds promise to create more efficient, durable connections between education and work. It can provide the technological fabric to help displaced workers translate their skills for new education opportunities and employers, and may hold particular value for those currently underserved by the existing education-to-employment paradigm." (Lemoie and Soares, 2020).

So why does blockchain hold such powerful promises? To answer this question, we need to understand the fundamental characteristics of blockchain technology and some of its major advantages. Blockchain has four intrinsic characteristics including decentralization, traceability, immutability, and currency properties; and major advantages such as reliability, trust, security and efficiency can be realized based on these characteristics. (Chen, et el 2018).
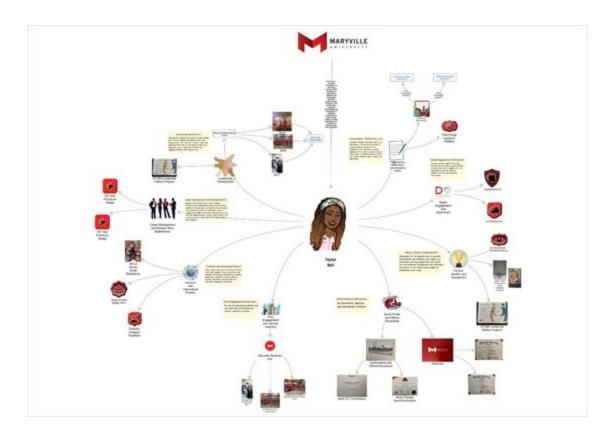
Since learning is a lifelong continuum, blockchain can help remove the barriers of the current arbitrary levels/grades of learning and enable personalized and adaptive learning as described in the IPPD model. Blockchain can be used to address the 2 fundamental issues in education: 1. Can learners tie learning and learning objectives more efficiently and effectively to acquire the knowledge and skills that are directly pertaining to getting jobs? 2. Can learning outcomes be easily recorded and verified, and furthermore be analyzed to create multiple pathways for learners to pursue? Blockchain smart contracts, on the other hand, can be used to determine what specific learning objectives and conditions are required, and then executed automatically when certain conditions are met. For example, a teacher could set up tasks for students. The completion of each task could be automatically verified by the blockchain's smart contracts. Upon completion of all tasks, students could be awarded with credits. Entire courses could be laid out this way. Specific skill assertions can be verified and communicated with a digital badge. Multiple badges can be assembled into an open badge passport that students can share with prospective employers (Art, 2018).

In Section 2.2.2, we describe the IPPD model to link integrative learning to inclusive adaptive development by emphasizing that a person's accumulated life, domain-general and domain specific skills do not have to be narrow, fixed and immovable. They can be reorganized, expanded and remixed in response to different contexts and evolving learner needs and aspirations. Continuous personal discovery is most likely to happen when learners are active participants in dynamic learning processes. Blockchain can greatly enhance the IPPD model by tokenizing learning. Tokenization can keep track of every learning when it occurs, it creates an immutable record that can be easily verified and analyzed to assess the learner's learning interest and competence. Tokenized learning can help create multiple pathways by breaking learning into smaller bite-size chunks and therefore to add more combinations of academic pathways, eliminate failures of a semester-long courses to help learners catch up at a much faster paste. Northeastern University and Arizona State University are both experimenting to convert digital badging programs created by IBM and Salesforce respectively into for credit courses. Learners will be rewarded with a token (a digital badge, certificate, etc.) as soon as they have achieved the learning objectives successfully.

Blockchain can also address such challenges as how to create and store credentialing outside of a specific authority such as the original employer or educational provider. In his article "The Path to Self-Sovereign Identity", Christopher Allen first introduced Self-Sovereign Identity (SSI), which he described as the Phase Four, the most current phase of identity following Phase One: Centralized Identity, Phase Two: Federated Identity, and Phase Three: User-Centric Identity. While acknowledging that there was no consensus re. the definition of SSI, Allen did offer 10 guiding principles, which would "attempt to ensure the user control that's at the heart of self-sovereign identity." (Allen, 2016). The first guiding principle of SSI is Existence, which states that "Users must have an independent existence". What it means is that users must have full access to their own records and complete control over what they may decide to do with the records and who they may want to share the records with. This guding principle directly addresses above mentioned challenge. Blockchain services that are SSI compliant can add additional security to protect the users identity and privacy. For example, Pistis.io, a blockchain platform service, that is featured in the ACE Report, lets its users have "full control over their records…" so the users can post, share, and verify their learning credentials independent from any associations of a specific authority.

A unique feature of blockchain is to let learners post their verifiable learning artifacts such as a video clip, a piece of music and a computer programming code, which can provide instantaneous audio and visual evidences of a learner's mastery and proficiency of certain knowledge subjects and skills. Pistis.io si currently the only blockchain service that offers its users to post learning artifacts on blockchain. The ACE Report states that "Pistis.io is a customizable platform that issues and displays verifiable credentials. It provides a shareable "Lifelong Learning Profile" where each credential is viewable along with learning artifacts." (Lemoie and Soares, 2020). So, on Pistis.io, users can actually show what they have achieved with verifiable learning artifacts instead of a resume with bullet points.

As we have stated previously that Integrative Professional and Personal Development (IPPD) is "lifelong," "life-wide," and "life-deep". Such learning takes place in everyday settings and family activities; the workplace and professional settings; designed spaces (such as studios, classrooms, museums and libraries) and programs of many types; and increasingly, online and via mobile technology. Blockchain as a distributed ledger technology (DLT) is the best tool to be used to capture every learning that takes place, both formal and informal learning, hard and soft skills across the lifespan of learner's lifetime. For example, Maryville University is currently implementing 2 strategic blockchain initiatives: Career Focused Student Digital Profile and Lifelong Student Digital Profile. The first initiative is built based on the eight career competencies established by the National Association of Colleges and Employers (NACE) (see the diagram below), which help Maryville students develop the soft and power skills that employers have been asking for. Once they complete the training, the blockchain solution will provide verifiable credentials with learning artifacts. The second initiative will address the lifelong learning needs and offer both the current and former Maryville students the ability to post, share and verify their own learning records on blockchain. New learning opportunities will be presented based on the learners' expressed needs.

Blockchain has disrupted many other industries such as fintech, supply chain and insurance, education will be no exception. To date, higher education blockchain use cases have focused on record keeping and efficiency, while the real disruptive power often lies in creating new business models. Woolf University, for example, was founded by a group of academics from both Oxford and Cambridge to become a blockchain-powered, nonprofit, borderless university. it will rely on blockchain and smart contracts as the basis of the relationship between learners and educators — aiming to create the Airbnb of degree courses (Moore, 2019). Maryville University in St. Louis, on the other hand, aspires to be the first blockchain university in the United States by focusing on: 1. Implement a career focused student digital credentialing solution on blockchain and provide its students with free digital degree diplomas and transcripts as well as job related soft and power skill digital badges and certificates that are readily shareable and verifiable; 2. Develop smart contracts to streamline and automate business processes; and 3. Tokenize education to create bridging programs between employment and academic degrees.

In a recent article "Betting on blockchain - A conversation with Feng Hou about blockchain and how it can change record-keeping" published by University Business on April 21, 2020, Feng Hou, the Chief Digital Transformation Evangelist at Maryville University in St. Louis, told the reporter that blockchain can be considered a "gigantic [un-editable] spreadsheet" that contains groups of records (or blocks) that are linked to each other. It can be used to provide a sharable and verifiable learning transcript that incorporates digital badges, certificates, awards and microcredentials alongside transcripts. The information can be aligned with learning objectives to ensure students are not left behind." (Helmer, 2020). Hou urges higher education institutions to develop a "blockchain first" strategy. Just like the "mobile first" and "cloud first" strategies that many higher education institutions have implemented in the past to support Anywhere and Anytime Learning, the "blockchain first" strategy will support lifelong learning and help create a truly learner-owned credentialing solution.

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